INTERFACE AGE™

COMPUTING FOR HOME AND BUSINESS APPLICATIONS VOLUME 4, ISSUE 10 OCTOBER 1979 $2.00
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The Microcomputer Goes to School

Pascal Notebook Chapter 4

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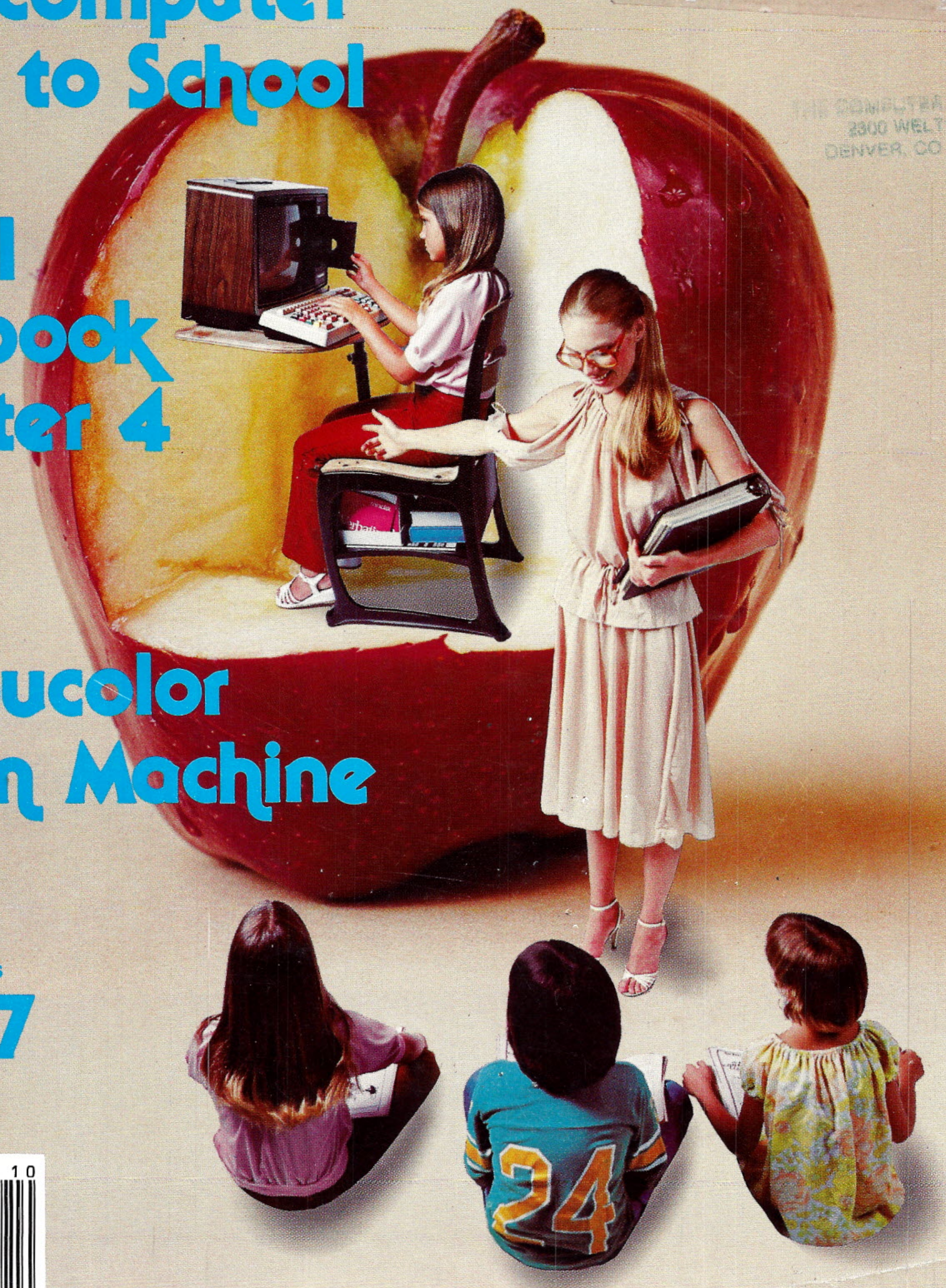

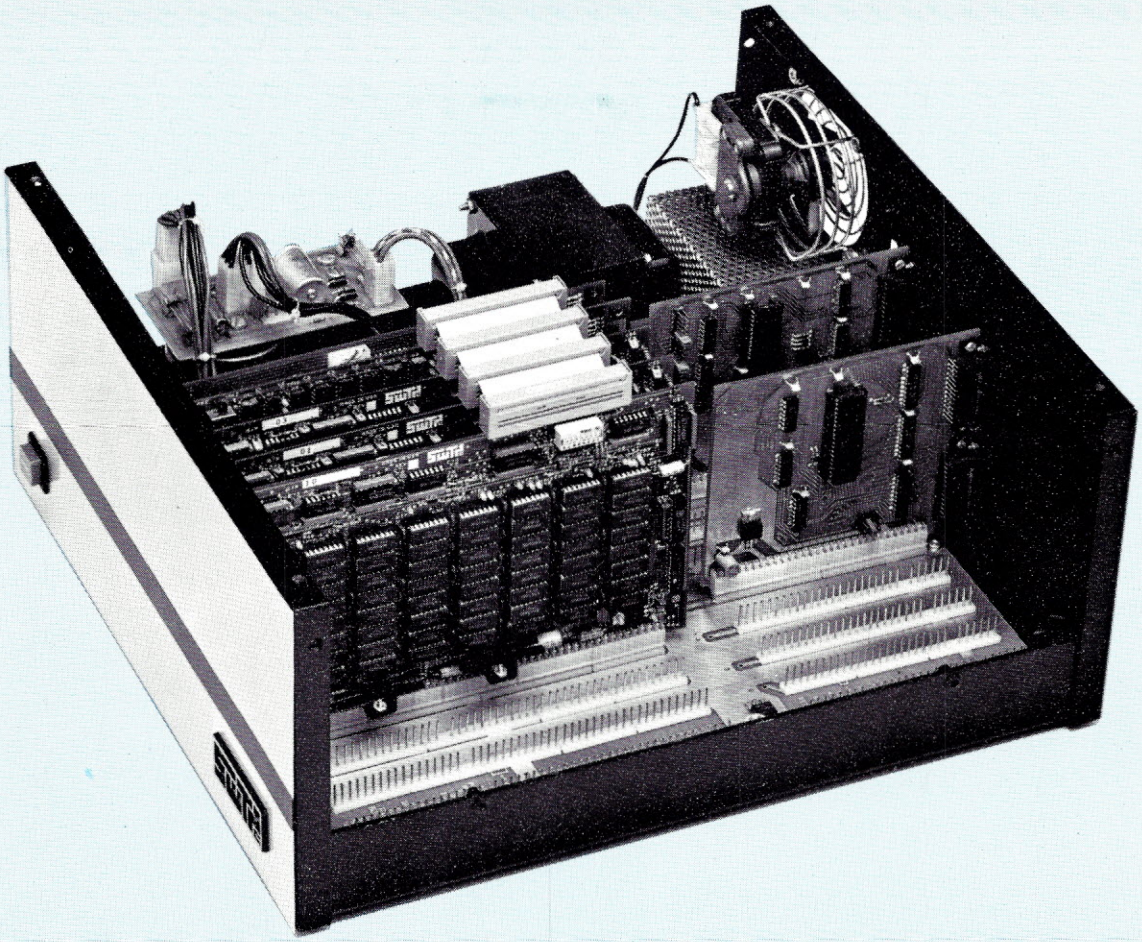

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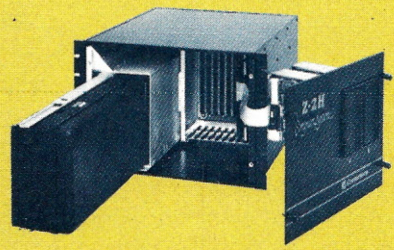

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VOL. 4, ISSUE 10
SINCE DECEMBER 1975
OCTOBER 1979

INTERFACE AGE™

COMPUTING FOR HOME AND BUSINESS APPLICATIONS

THIS MONTH'S COVER
Cover photo by Don May. Design by Fino Ortiz, Art Director. Models are Sharon Miller, Heather Mazenko, Tami Warren and Robert Ortiz. Computer courtesy of Compucolor. Desk provided by Dorothy Byrne.

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EDITOR'S NOTEBOOK

A VIEW FROM THE TOWER

An editor of a magazine has a number of duties, several of which are fairly easy to figure out. There are some that come with the territory. In my case this means being an industry watcher.

Being an industry watcher can mean several things, but for the major part it refers to keeping an eye on new technological advances from the hardware makers, finding out what software geniuses are doing and trying to get a handle on how everything is coming together for the benefit of INTERFACE AGE readers.

There does happen to be more in being an industry watcher. That is in relationship to watching what the industry people are doing or think they are doing.

The microcomputer industry, which just about anyone you talk to credits to Ed (remember MITS) Roberts, has already made several full circles since its inception about four years ago. We have seen everything from new hardware concepts based on new and unfounded ideas to introductions of equipment and software based on firm, tried-and-true methods — with the cycle repeating itself every few months when a new company enters the arena and one or two others go under for the third time.

What has been more interesting is the cycles the people associated with the industry have gone through.

When all this started out, Adam Osborne was a Ph.D. with a consulting business and a fair amount of guts and insight, which within a very short period of time caused him to become known as a guru. Now within less than a year's time, Adam has left gurudom to a higher level of attainment as a good businessman with a modicum of respectability. At the same time, other self-proclaimed gurus who had a degree of backing from prestigious companies are beginning to be found out for what they are, and their respectability is falling in logarythmic proportions.

More distressing is that magazines and companies who would never have given credence to the micro phenomenon before are now giving indications that it was all their idea. IBM is making noises about a low cost system that will revolutionize the small business DP industry. If it is real and software exists, it most likely will change the industry, since it is very difficult to compete against a company with more money than the federal government.

A new group of industry-created and self-proclaimed gurus are beginning to show their heads. Some have been able to get government funds to do special studies on the social and economic impact of the so-called personal computer, and at the same time give pseudo-prestigious seminars on whether or not personal computing is worth it. All I can say to that is, "Come on, it's time to drop the BS from the microcomputer game and settle down."

The Maxi and Mini world have been plagued for years with so-called experts and consultants who were nothing more than ordinary flimflam men and women. Unfortunately we have the same in the micro world. Their ranks are growing every day, mainly because you, the reader, are helping give them respectability in your desire to obtain DP help and understanding.

Believe it or not, 80% of the seminars you go to are to tell you how smart the speaker is, not to help you or educate you. That fellow down the street who calls himself a consultant — what are his credentials? Look back in my notebooks and letters to the editor recently and see how many consultants have surfaced. Some are good and some are bad. I would choose to guess that a majority are bad. From my experience, they cannot even answer the most fundamental of questions about good application planning. Many talk a good game, but few can carry the ball.

My suggestion to professional engineers and businessmen who read INTERFACE AGE is to quit supporting the lip waggers; but make sure that the movers and shakers get the support they need. Remember there are surely more Bemers, Wirths, Martins, Dijkstras, and Hoppers out there making significant contributions to the data processing industry.

GOLDEN CLASSICS

A number of you have written or called regarding a number of articles that were printed in INTERFACE AGE over the years to find out if reprints or back issues were available. Back issues are almost gone, but we have a super surprise: we are working feverishly to finish THE BEST OF INTERFACE AGE, Volumes 1 and 2 — Software for John Dilks' October show, as I mentioned in July.

This volume of software will include large-size listings of Lawrence Livermore BASIC, NIBL, Palo Alto tiny BASIC and Uiterwyk's 4K tiny BASIC. That's right, a complete source listing supplied by Bob Uiterwyk himself. It will be placed in the public domain on publication of the INTERFACE AGE Classic.

Although all these BASICs would make the book worth it, we have included a number of Alan Miller's best routines. Because many asked, the best of Peter Reece — from his cross assembler to his database management system — will be included. All the software in the book has been re-assembled or re-listed in BASIC, and published to be fully readable. We tried to include everything you wanted in these two volumes, but we did leave out business. That is planned for later volumes.

All volumes will have more software than you can use in a lifetime. We plan to publish these Classics about every 18 months, featuring only the very best of general and business software.

SPEAKING OF SOFTWARE

Many of you have expressed an indication that you like our move to more business orientation. We feel that this is an important area which deserves as much support as we

can give it — watch for the businessman's handbook in November. However, to do this we need more business software from you. We are currently looking for some unusual business offerings such as an APPLE application for the optometrist to display a diagram of an eye, allowing the doctor to make indications on it then save it in a patient file.

I recently talked to three of the coroners who were attending the American Airlines crash in Chicago, and discussed some of the difficulties that arise when collecting data from a major disaster. Although that may sound tasteless, it is a part of life which must be addressed.

We would very much like to receive an article on what a coroner needs informationwise, with a program that assists him or her in the collating of that information. In the recent air disaster, handling and matching up personal property of the deceased was a major problem for the disaster teams.

Along those same lines, has anyone worked out a program to assist medical students in the study of anatomy by displaying different structures such as bone, muscle, etc.?

How about the use of fiber optics in the transmission of data or video information? Does anyone at TI want to write about this?

I am also looking for articles on telecommunications, electronic mailboxes and robotics. Specifically software articles on how to make the robot work and function. An important area we want to see addressed is the use of the micro in solving the energy problem.

IT'S READY

The new INTERFACE AGE Style Guide is off the presses and is available now. You can either pick it up at the Personal Computer Convention in October or send a legal-size self-addressed stamped envelope to: Style Guide, INTERFACE AGE Magazine, P.O. Box 1234, Cerritos, CA 90701.

WHO I REALLY WANT TO HEAR FROM

I consistently hear from everyone using the micro in business or home, but I very rarely hear from the non-DP'ers. What we would like to find out, and so would a number of personal computer companies, is do you want a micro in the house to balance your checkbook, turn the sprinkler on, or play football with you?

In other words, Mr. and Mrs. America, where is the personal computer industry going in your opinion? Is there a personal computer industry? Will computers be in every home? Rather than let us so-called experts shoot our knowledgeable mouths off, you tell us. Write to: I THINK, INTERFACE AGE Magazine, P.O. Box 1234, Cerritos, CA 90701.

—carl

CALL FOR ARTICLES

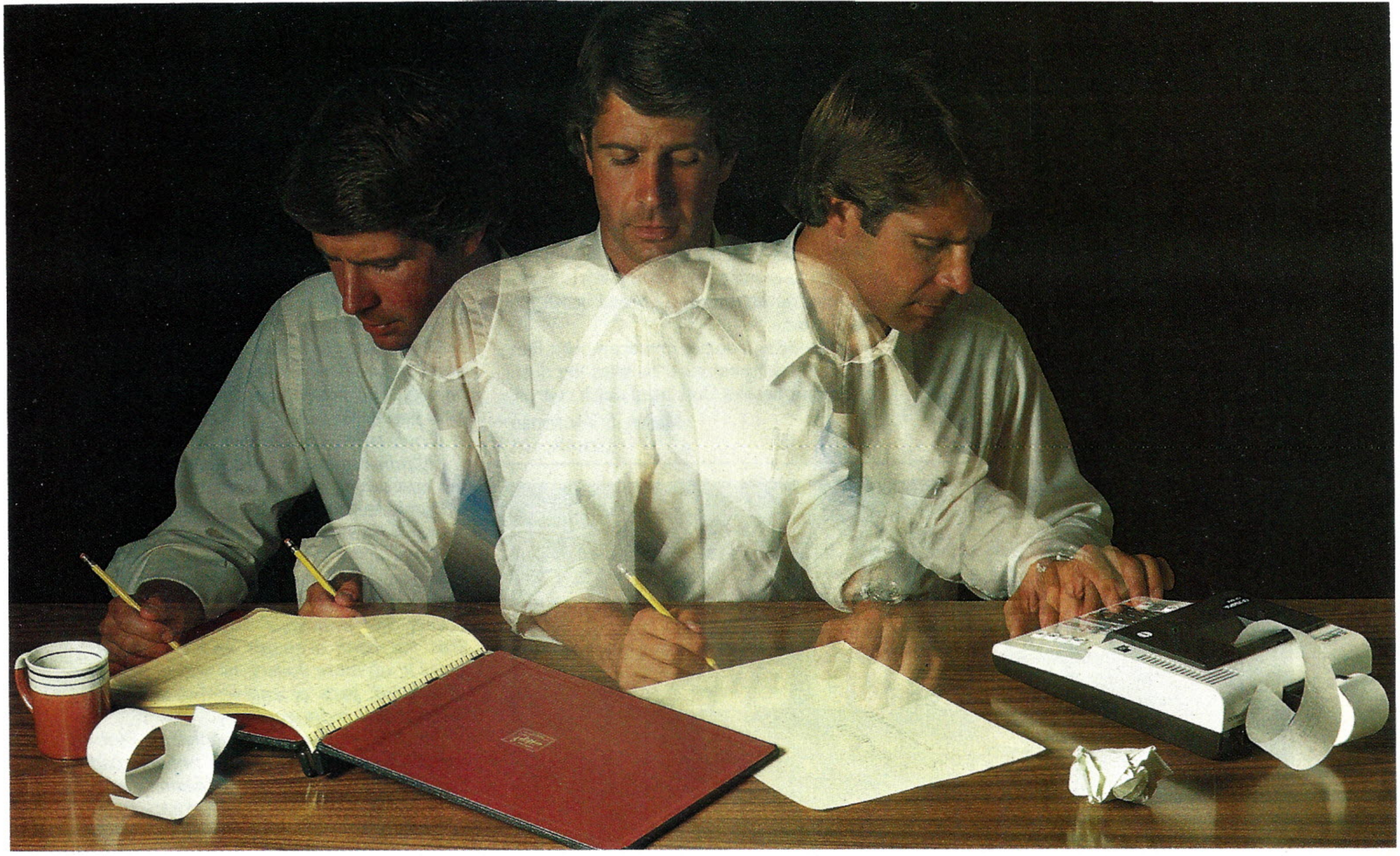
INTERFACE AGE is seeking articles on hardware and software, particularly concerning Apple, TRS-80, Atari and Heath computer systems. Other areas of interest include medical and educational applications, special functions of microprocessors, telecommunications and video graphics, both on screen and hardcopy.

Payment ranges from $20 to $50 per published page. Articles describing company projects or products carry the company byline, but no payment is offered. Submittals should include an abstract, outline and return envelope.

Manuscripts should be typed, double spaced with 1" margins. Minimum length is 4 pages, unless programs are included. Photos should be numbered and have a brief description attached. Tables, listings, etc. should be on separate pages. Computer listings should be printed using a new ribbon to assure good reproduction. Authors are requested to submit a statement of their background and expertise.

The publisher assumes no responsibility for artwork, photos or manuscripts. No acknowledgement is made unless accompanied with a stamped return envelope.

For submission or details contact Carl Warren, Editor-in-Chief, INTERFACE AGE Magazine, 16704 Marquardt Ave., Cerritos, CA 90701. Please do not phone.



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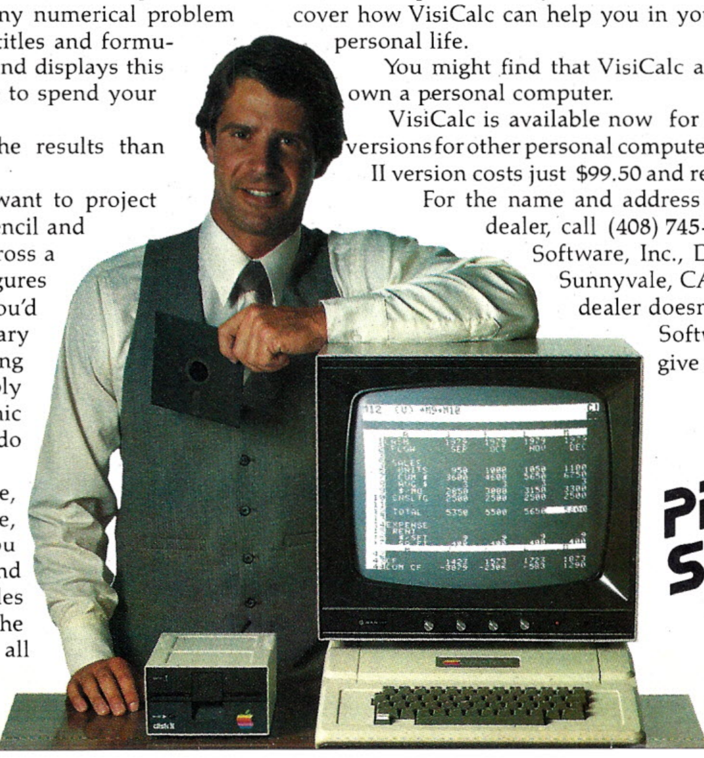

PERSONAL SOFTWARE

CIRCLE INQUIRY NO. 73

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SWEPT UNDER THE RUG

Dear Editor:

The June issue of INTERFACE AGE has been on my desk for some time with the magazine opened to page 13 and your article headed "THE TRADES DO IT AGAIN."

I am very surprised with your reasoning to hide the bad knews from the poor slobs who just might end up holding another short stick in the microcomputer sales game.

The article in *Electronics News* didn't hasten the road to bankruptcy for any company discussed therein. If it really gets down to who is doing what to whom, there is hardly an industry in this country that is not watched over by the "trade" press and the public is far ahead in general because of their efforts.

I don't believe that you want to make the microcomputer industry a protected field from the rest of the electronics industry; if you want to argue a point you think is incorrect, then do so, but don't broad brush the whole effort.

And so today, another microcomputer firm that once held great promise bites the dust. Someone, besides God, must watch over us.

Martin J. Weitzman
Loomis, CA

Mr. Weitzman does bring up a valid point, industry does need some form of watchdog. However, being a watchdog is one thing and irresponsible reporting another. The Electronic News *article gave the impression that the entire microcomputer industry is on the skids, something that is definitely not so.*

What is interesting is that Electronic News *made no effort to report financial problems a major Southern California mini maker is having. The major trade tabloids still are only paying lip service to the micro world, and only when scandal can be reported.*

My purpose in June was not to downplay the companies that suffered bankruptcy. I sincerely feel most of them deserved it because of their inadequate management.

Many of the companies went down the tube because of what I call "three-piece suit fever." The company started making a few dollars, the principals' heads got bigger than the bank accounts and before you know it, no more dollars; no way to pay for advertising, parts or engineering and consequently no more company.

Yes, Mr. Weitzman, I agree that the problems companies suffer should not be broad brushed. But care should be taken in possibly forcing a potentially good company into bankruptcy through poor judgment in reporting. —*carl*

'FIX' CONVERSIONS

Dear Editor:

In the June 1979 issue of INTERFACE AGE on page 38 is a most useful program, even though such conversions have appeared here and there in other magazines from time to time. One, I recall, converted decimal numbers to other bases. Another converted any base to any other base, an interesting though somewhat dubious capability. Written in PolyMorphic BASIC, the program in the June issue might be a little difficult to implement as it stands by those of us with other BASIC languages. I would propose three simple modifications to aid the "not-so-diehard" programmer.

I happen to be using MBASIC with CP/M, but these mods could apply probably to any of the Altair-type BASICs.

First, and most obvious, replace the multiple-statement delimiters shown as "\" with ":".

Second, replace the following expressions with new ones:

Line	Old Expression	New Expression
173	Q$(A,A)	MID$(Q$,A,1)
225	B$(K,K)	MID$(B$,K,1)
320	O$(K,K)	MID$(O$,K,1)
425	H$(K,K)	MID$(H$,K,1)

Third and perhaps most important, it may be necessary to control via software the round-off error inherent to your interpreter. The test is to select an input base of "H" and an output base of "B". Then for the HEX number use "FFFF". If the computer prints "1111111111111110" instead of all 1's, then you have this problem. The

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same type of error can be observed by outputting to octal instead of binary. The above input would give octal output "177776" instead of "177777". The cure is to add *.5* to the last statement in lines 70 and 110 and find the *INT* (integer) of the right-hand side of the statement (e.g. line 70: N(K+1) = INT(N(K)−(K)*M+.5).

These changes seem to solve the problems I had with the program. Perhaps some of your readers found the same difficulty and would like the "fix."

Jon Lindsay

Jon, thank you. Your fix helped a great deal.

FAMILY TREE SOFTWARE WANTED

Dear Editor:

I would very much appreciate your making a brief note in your publication about a specialized interest of mine in the hope that it might be read by others of a similar interest.

Briefly, I bought an Apple II (6502) microcomputer last year in the hope that it would bring order out of chaos in the collected documentation I have of several thousand ancestors. I would like to be able to store, file, sort, retrieve, and cross-reference genealogical data. I would like to be able to have pedigree, individual and family group printouts as well as indexes. The Mormons have done excellent work, but they use IBM 370s. Some work out of the University of Utah has focused on minis using an excellent soundex code with pointer systems for parents and progeny, but the adaptation to micros is not clear.

I would like to hear from others of a similar interest (it also has relevance to tracing genetic disorders and there are other analogs) so that possibly a network of information could be pooled and shared.

Clifton Howard, M.D.
58 Van Orden Rd.
Harrington Park, NJ 07640

Associate Editor Jim Schreier has just the article, which will be coming up shortly.

A LOT TO SAY

Dear Editor:

About a year ago I had subscriptions running for five of the many computer magazines on the market and one newsletter. This year, as inflation started taking its toll on my purchasing power, I took a serious look at my subscription list. I found that for the most part I only read two of the magazines and the newsletter thoroughly and often enough to warrant continuing them. One of the two was INTERFACE AGE which I look forward to, as I do the other one, every month. Keep up the good work and keep it coming.

I have written a letter to Mr. John Dilks regarding some ideas which I thought might be of interest and of value to him regarding Personal Computing 79, which I was very pleased to see you announce. A couple of those ideas are sort of unknown quantities, and I thought you — by publishing part of my letter or soliciting response from your readers in some other way — could evaluate the amount of appeal these ideas might have to people who may be attending Personal Computing 79.

The first of these ideas is the possibility of having some special program activity for computer widows, the wives of computerists who are either not interested or possibly who don't know much about microcomputers. My wife showed some real interest when I mentioned the idea to her. That, it now occurs to me, raises the question of what sort of program might interest them?

My next idea occurred to me as I was answering a letter from a reader of Physicians Microcomputer Report, which I mentioned in a letter to Dr. Orosz. That is the possibility of people who, like myself, are involved in or are interested in microcomputer applications for various segments of the health care industry getting together to swap ideas and experiences and perhaps establish some ongoing communications among some of them. This group of unknown number I refer to as health care microcomputer entrepreneurs. Arrangements for such a meeting could be adapted to the number of interested parties.

Those are the ideas. What they may amount to, how much interest they may stimulate, I have no idea. You, Mr. Dilks, Dr. Orosz and Adam Osborne probably have a far greater sense of whether either of these ideas has much potential or not. In the event that no one else is interested in carrying the ball, I would be interested in hearing from any 'health care microcomputer entrepreneurs' who are planning to attend Personal Computing 79 and would like to get together for some chit chat and to exchange names and addresses.

As I really am not in a position to carry the ball for the computer widows idea, that one I'll leave purely to the judgement of you gentlemen who know the territory better than I could possibly hope to.

Thomas H. Swalenberg
Health Care Systems Management Services
P.O. Box 13089
Columbus, OH 43213

Well, Tom, it's hard to say what will and won't be of interest. Last year at John's show just about every special interest group found someway to get together. Since it's your idea, why not have everyone get in touch with you and pick a specific meeting place, say in front of the INTERFACE AGE booth — you won't be able to miss us.

KEEPING ME HAPPY

Dear Editor:

I am extremely pleased with the content and format of your magazine. I receive all the major home/small business oriented computer magazines, and your magazine would be an excellent example for some of the others to copy. "Copying is the highest form of flattery" etc. etc.

W. Douglas Wilkens
Womelsdorf, PA

Get big system performance from your small computer

Bigger isn't always better, but large-system experience and a national communications network can help you get more out of your small computer.

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MicroNET

COMMENTS ON TDL BASIC

Dear Editor:

I enjoyed John Lehman's article on SABR (May '79). I was particularly glad to see his method of performing data I/O from TDL's BASIC.

However, to get one point out of the way first; my version of TDL's 12K BASIC uses SWITCH 1 to return to the console after using SWITCH 2. Your article used SWITCH 3. It could be that the 8K and 12K BASICs differ on this point.

I purchased a XITAN computer along with TDL's 12K BASIC, Text Editor and Assembler. I implemented a controlled cassette reader via the method of TM #106 in order to use the editor and assembler. Needless to say, the time consumed reading and rewinding tapes became very frustrating.

So I "graduated" to a North Star disk operating system. It did not take much effort to combine the ideas in TM #106 with the North Star DOS primitives to be able to SAVE and LOAD TDL BASIC programs and editor and assembler files on disks. However, saving and reading data from TDL's BASIC programs has eluded me — till now.

My method of using North Star disk files with TDL programs consists of jumping to the ZAPPLE monitor and using modified "K" commands (per TM #106) to NAME and OPEN disk files for reading and/or punching. Then I 'G'o back to the TDL program to read or save the file. If I am punching, another jump must be made back to the monitor to read in the last buffer and close the file.

Until I read your article, I had never thought of using the LPRINT operation to get to the punch. Now, after opening a file as described above, I can switch the printer to the punch via a POKE instruction and LPRINT the data to a disk file. When reading in data, I dummy the printer by POKEing a return (C9) at its address. Below is a listing of the program segment used to accomplish these operations.

William F. Curran
Austin, TX

```
3000 REM - SUBROUTINE TO SAVE FILES
3010 REM - FORMAT IS FILE LABEL,#V, #C, INDIVIDUAL LABELS, V1C1,V1C2,ETC
3020 PRINT:PRINT:?"STARTING SAVE":PRINT :PRINT
3050 POKE &F816,&78  REM SWITCH PRINTER TO PUNCH ROUTINE
3060 LPRINT T$: LPRINT VB: LPRINT CS
3070 FOR I=1 TO VB: LPRINT L$(I): NEXT I
3080 FOR I=1 TO CS: FOR J=1 TO VB: LPRINT D(I,J)
3090 NEXT J: NEXT I
3095 POKE &F816,&32  REM RESET PRINTER ADDRESS
3100 PRINT:PRINT"CLOSE OUTPUT FILE" : STOP
3110 PRINT:PRINT "DATABASE SAVED":PRINT
3120 RETURN
3200 REM - LOAD DATABASE FROM FILE
3225 POKE &F815,&C9  REM DUMMY OUT PRINTER WITH 'RETURN' (C9)
3230 SWITCH2
3240 INPUT T$: INPUT VB: INPUT CS
3250 FOR I=1 TO VB: INPUT L$(I): NEXT I
3260 FOR I=1 TO CS: FOR J=1 TO VB: INPUT D(I,J)
3270 NEXT J: NEXT I
3280 POKE &F815,&C3  REM RESET PRINTER JUMP (C3)
3300 SWITCH 1
3310 PRINT "FILE LOADED"
3320 GOTO 350
```

A NEW LANGUAGE?

Dear Editor:

I am somewhat amused by all the attention being paid to the language Pascal. Certainly it is far better than BASIC currently being used in microcomputers. But, if the trend towards compiled languages continues, programmers would do well to look at C.

For sheer ease of programming C just can't be beaten. Its concise syntax and totally free format gives power and legibility (simply lacking in BASIC). The obtuse syntax of Pascal is simply an eyesore compared to C (for example 'BEGIN' and 'END' are replaced by { & } in C).

Perhaps you should look at this language even though it's available mainly under UNIX in minicomputer systems like the PDP-11 (for which it was designed). Currently I'm writing a C-compiler for Z-80 based systems (TRS-80) and several of my friends (C addicts all) are anxiously waiting for its completion.

Francis Pinteric
693 Camelot Dr.
Sudbury
Ontario, Canada

It appears that everyone has his or her special language. Personally, I think Pascal is OK; BASIC is ideal just because; but English — and it's coming — works best.
—carl

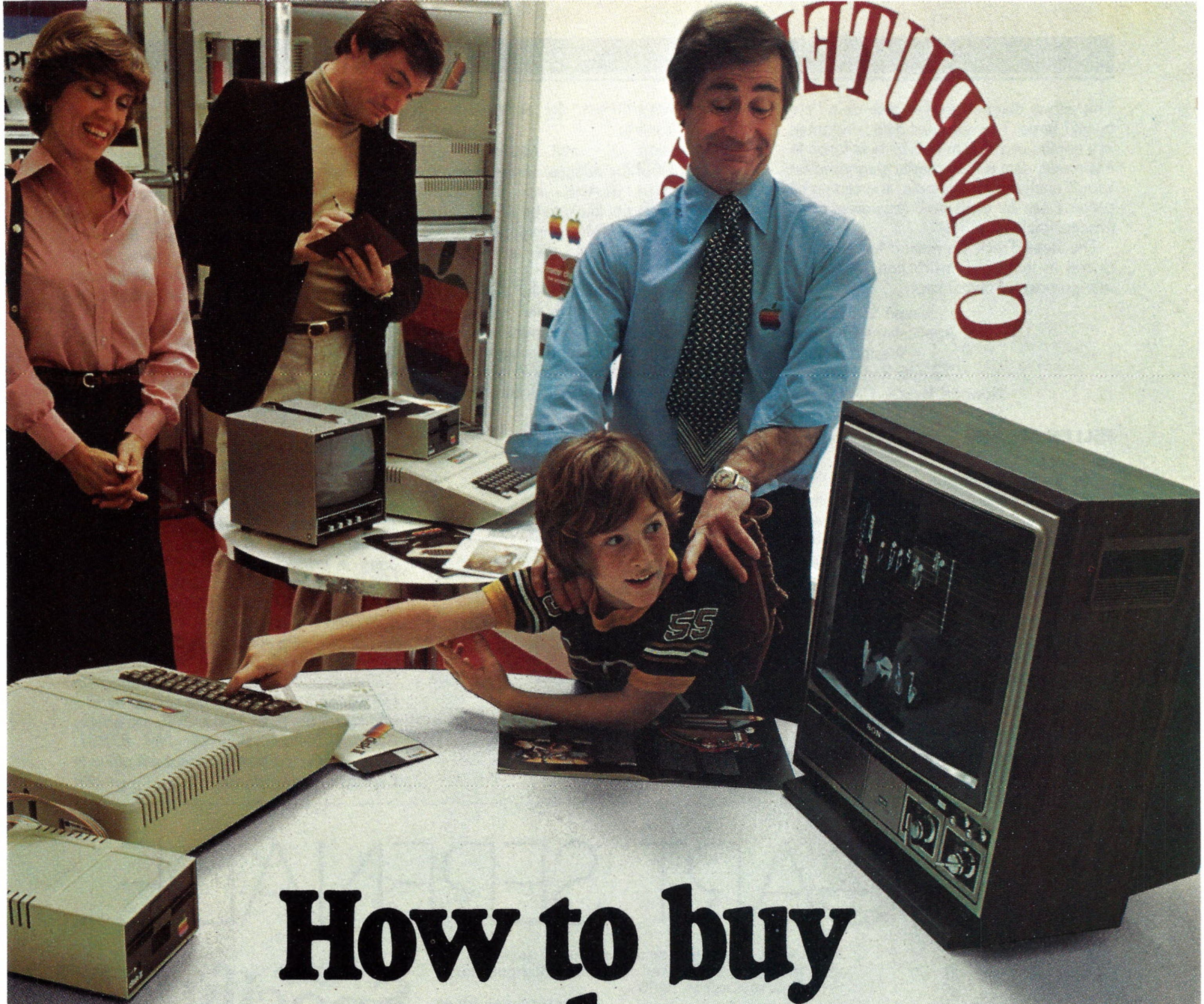
I KNOW WHAT "S" IS

Dear Editor:

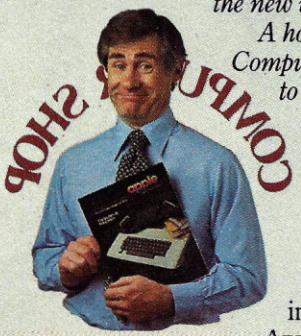
In your *Letters to the Editor* section of the May 1979 issue, Bob O'Brien stated that he could not find the purpose of the "S" bit in Western Digital's 1771 Floppy Disk Controller Chip. I hope the following explanation will help Mr. O'Brien and other readers.

When the "S" bit of the Read Track Command is set to a zero, the 1771 will synchronize the data stream when each address mark (with missing clocks) is read off the diskette. This allows for diagnosing disk problems by providing a "byte-by-byte" transfer to the data register. All data, gaps and address marks appearing on the disk are sent to the data register.

When the "S" bit is set to a one, synchronization on every address mark is inhibited.



How to buy a personal computer.



In California, a store owner charts sales on his Apple Computer. On weekends though, he totes Apple home to help plan family finances with his wife. And for the kids to explore the new world of personal computers.

A hobbyist in Michigan starts a local Apple Computer Club, to challenge other members to computer games of skill and to trade programs.

Innovative folks everywhere have discovered that the era of the personal computer has already begun—with Apple.

Educators and students use Apple in the classroom. Businessmen trust Apple with the books. Parents are making Apple the newest family pastime. And kids of all ages are learning how much fun computers can be.

Visit your local computer store

The excitement starts in your local computer store. It's a friendly place, owned by one of your neighbors. He'll show you exactly what you can use a personal computer for.

What to look for

Your neighborhood computer store has several different brands to show you. Chances are the salesman will recommend an Apple Computer. Apple's the one you can program yourself. So there's no limit to the things you can do. The more you use your Apple the more uses you'll discover. So it's important that Apple is the computer with more expansion capability. You can't outgrow Apple.

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apple computer

This allows diagnosing disk data on a "bit-by-bit" basis. The recorded data is returned in a continuous stream in 8-bit byte form. In this mode, data is more easily diagnosed on a logic analyzer, for example, and certain bit patterns can be evaluated, regardless of its hexadecimal value.

The Read Track Command has been included in the 1771 instruction set for the sole purpose of diagnostics.

Joseph V. Jaworski
LSI Applications Engineer
Western Digital
3128 Red Hill Ave.
Newport Beach, CA 92663

MILLER SPEAKS

Dear Editor:

I'm always suspicous of assembly-language listings that don't give the resulting machine code. Take a look at the listing from the May 1979 issue. The labels COMMA and BLANK are not defined as equates but as memory locations. A symbol table would not give the value 20H for BLANK, but rather its memory address. While this is an inefficient way to define ASCII characters, it could be done. The use of the expression:

```
LDA  BLANK
```

would pick up the value.

The expression:
```
BLANK  EQU  20H
  MVI  A,BLANK
```

is better. Nevertheless, the enclosed program won't work.

The expression `MVI A,BLANK` will load half of the address of the memory location called BLANK into the accumulator. This is not likely to be a 20H. The same is true of COMMA. This appears to be a serious breach on the integrity of INTERFACE AGE.

A less serious problem is the sloppy and inefficient programming in the rest of the listing. INTERFACE AGE programs should provide examples of good programming, not just a simple-minded way to get the job done. Consider the several occurrences of the construction:

```
MOV  A,M          (lines 13-17, 37-41, 57-59)
XCHG
MOV  M,A
XCHG
```

This can be done in two instructions:

```
MOV  A,M
STAX  D
```

The construction:
```
INX  H(lines 16-18, 40-42)
XCHG
INX  H
```

can be:
```
INX  H
INX  D
```

Then:
```
LHLD   LNAME     (lines 9-12)
XCHG
LHLD   ALINE+5
XCHG
```

can be:
```
LHLD   ALINE+5
XCHG
LHLD   LNAME
```

Finally,
```
MVI  A,COMMA     (lines 30-31)
MOV  M,A
```

might be:
```
MVI  M,COMMA
```

(Except that comma isn't properly defined).

The labels LNAME, FNAME, MI, and ALINE+5 seem to be undefined. If you insist that authors submit flow charts, it will force authors to think about their programs. Also, authors should submit an actual computer printout of the program.

Alan Miller
Software Editor

Although this was an internal staff letter, I am printing it due to the important points brought out.

Regarding flow charts — we do insist on them even though we may elect not to print them. They are the guideline for thinking and that is exactly what programming is, a structured form of thinking.

Yes, we admit that occasionally a program is printed that was not fully tested. However, in most cases a program is verified. To eliminate these problems, all Z-80, 8080 and BASIC programs, with the exception of business software, will be evaluated by Dr. Miller, who is now software editor.

Therefore, those who are planning on submitting a software article should send it directly to: Dr. Alan Miller, Software Editor, Campus Station, Socorro, NM 87801. Send all others directly to our main office in Cerritos to my attention. —*carl*

TRS-80 IN SCHOOL

Twenty-five Radio Shack TRS-80 microcomputers have made their way into the school system of Cotulla, Texas, a small town with a population of 3,500.

One thousand of the 1,500 students are involved with computer assisted instruction. The Cotulla School District serves students in elementary school with twice weekly twenty-minute drill and practice sessions in mathematics. The software utilized is a kindergarten through eighth grade microcomputer mathematics curriculum produced by the Dallas Independent School District.

The K-8 mathematics curriculum, complete with 36 tapes (addition, subtraction, multiplication, division, fractions, decimals, numeration, teacher's manual and progress forms) is available from the Foundation For Quality Education in Dallas for less than $1,000.

Amortizing the hardware and software costs over five years allows the Cotulla Schools to have a cost of less than 30 cents per student contact hour for their program.

FCC APPROVES ATARI PERSONAL COMPUTERS

Atari Inc., a division of Warner Communications Inc., has received Federal Communications Commission Type I approval for its new personal computers — the Atari 400TM and the Atari 800TM Personal Computer Systems.

FCC approval permits owners of Atari's personal computer systems to legally connect their computer directly to any TV set. Unlike many other personal computers on the market, Atari units produce no detectable interference with local radio and television reception.

This event represents the culmination of 3½ years of research and development efforts. With FCC approval, Atari is free to sell and advertise the personal computers. Both systems will be distributed this fall to a mix of computer specialty retailers as well as several major national retail chains.

NEW BI-MONTHLY JOURNAL FOCUSES ON DATA CAPTURE

Datanetics, a new bi-monthly journal of data capture applications news, is designed to provide information about contemporary state-of-the-art solutions to data entry problems. Directed to the manager, director or officer responsible for the capture of data for computer processing, *Datanetics* is provided at no charge to those who qualify.

For information and a sample copy contact Scan-Data Corp., 800 E. Main St., Norristown, PA 19401, (215) 277-0500.

REGISTRATION & ADMINISTRATION SOFTWARE FOR SCHOOLS

BTI Computer Systems of Sunnyvale, California, has available Chama Corporation's System Oriented Administration Registration Software, SOARS/5000, on BTI Model 5000.

SOARS/5000 provides schools and colleges with a complete timesharing system for administration and management. It is structured in three functional modules: school administration, business accounting, and development/alumni, and tends to all the record-keeping and bookkeeping functions normally associated with student admission, registration and grading; general ledger, student accounts, accounts payable, and payroll; and development programs.

STUDY PREDICTS $22 BILLION IN COMPUTER SALES

It is universally forecast that the market for small business computer systems (SBCs) is on the threshold of an "explosion" of thermonuclear proportions. Even a "conservative" study by Frost & Sullivan still sees that explosion amounting to an atomic blast.

By 1987, the industry will have installed some $15 billion worth of minicomputer-based systems and another $7 billion worth of microcomputer-based systems whose shipments currently may be considered nominal.

Already, the 338-page study notes, "microcomputer-based systems have resulted in fundamental changes in the computer marketplace; small unsophisticated users having minimal background are now becoming involved in data processing."

Decreasing system prices, of course, are largely responsible for this market penetration. Software and peripherals will create the largest opportunities for independent industry suppliers "to make significant sales," the study notes.

Among end users, the retail sector will account for the greatest single market segment by far and away, followed by also healthy market shares for wholesale distribution and manufacturing, in that order.

The study, which is titled "The Small Business Computer Market," — and includes a directory of 100 CPU-makers, 77 software vendors, and 165 peripheral manufacturers — takes pains to distinguish between the mini vs. the micro market segments. Very few microprocessor-based machines, it notes, exceed $10,000 in price, "even when all peripherals are included." Most minis start at $10,000, it adds.

Numerous technical differences exist as a result, pertaining to communications capabilities, storage capacity, terminal support, number of registers, instruction repertoire, software, physical size, and word size, among others.

Vendor competition comes in for an in-depth analysis in the study. In the micro segment, a new market leader has emerged each year since its origin. Altair in 1976; Imsai in 1977 and Apple in 1978.

For further information contact Customer Service, Frost & Sullivan, Inc., 106 Fulton Street, New York, New York 10038, (212) 233-1080.

the Column

By William M. Karnes

SOFTWARE LEGAL PROTECTION

Can software be protected, and if so, how is it done? This question is asked time and time again. The answer is, "Yes — maybe, but do you want to or need to protect your software?" Software, and hardware, is constantly changing. The traditional methods of protection have been patents, copyrights and trade secrets. Each area is an article in itself, and all three methods have been used in an attempt to protect software.

The copyright law is set forth in Title 17 of the United States Code. The law was passed in 1909 and revised in October of 1976 with a generally effective date for the revisions being January 1, 1978. Copies of copyright pamphlets can be obtained by writing the Copyright Office, Library of Congress, Washington, D.C. 20559, or possibly from a local federal office building.

EFFECTS — HELP OR HINDRANCE?

As with any hot issue, there are proponents and opponents of software protection. Copyright protection for software is increasing in popularity because it is a cheaper form of protection which requires less time and effort. In fact, the large hardware manufacturers have increasingly utilized this method of protection for their software.

Copyright protection for software is increasing in popularity because it is a cheaper form of protection which requires less time and effort.

The large manufacturers hope that copyrighting will curtail and discourage reproduction of their programs and enhance their software market. Copyrighting will at least reduce, if not negate, resale of these programs by someone other than the manufacturer. Educational institutions, small businessmen and hobbyists, on the other hand, desire cost-free or minimal cost access and utilization of these programs.

It is no "trade secret" that software development lags far behind hardware. There are millions of people waiting for affordable software. Why the void? Time and money. Although programs can be cheaply copied, it requires kilobauds of time and money to develop a program which works. Even if time is available, where is the money? The prospective financial backer will be more inclined to invest if work is protected by copyright and therefore marketable for profit with less likelihood of being copied.

Unfortunately, it is unknown just how much protection copyright

will afford. The copyright laws are general and therefore interpreted by the courts on a case by case basis. Just as the threat of a strike is better than the financial problems of a strike itself, so too the fear of a copyright infringement is more desirable than the time, money and attorney's fees of a lawsuit which could financially exhaust or destroy a small software manufacturer.

One possible protective measure for a newly developed program is to redo it in two or more languages and copyright them all at the same time since the bulk of the work will be expended in developing the initial program.

If a program is modified and sold without the author's permission, will a copyright offer protection? Probably only a court decision will provide the answer. Some legal experts feel that while the program is protected, the *idea* expressed in a different program is not protected. A copyright may be infringed by someone who makes changes in the program. Only a case by case determination will decide whether a specific copyright has been infringed, taking into consideration the format, language, number of changes, etc.

Interestingly, the copyright law covers translations. There were obviously no computers in 1909, and the copyright protection for "translations" referred to French, German, etc. Today, however, the language of FORTRAN can be "translated" into COBOL, BASIC, etc. Whether these software "translations" of a copyrighted program are protected has yet to be determined by a court of law.

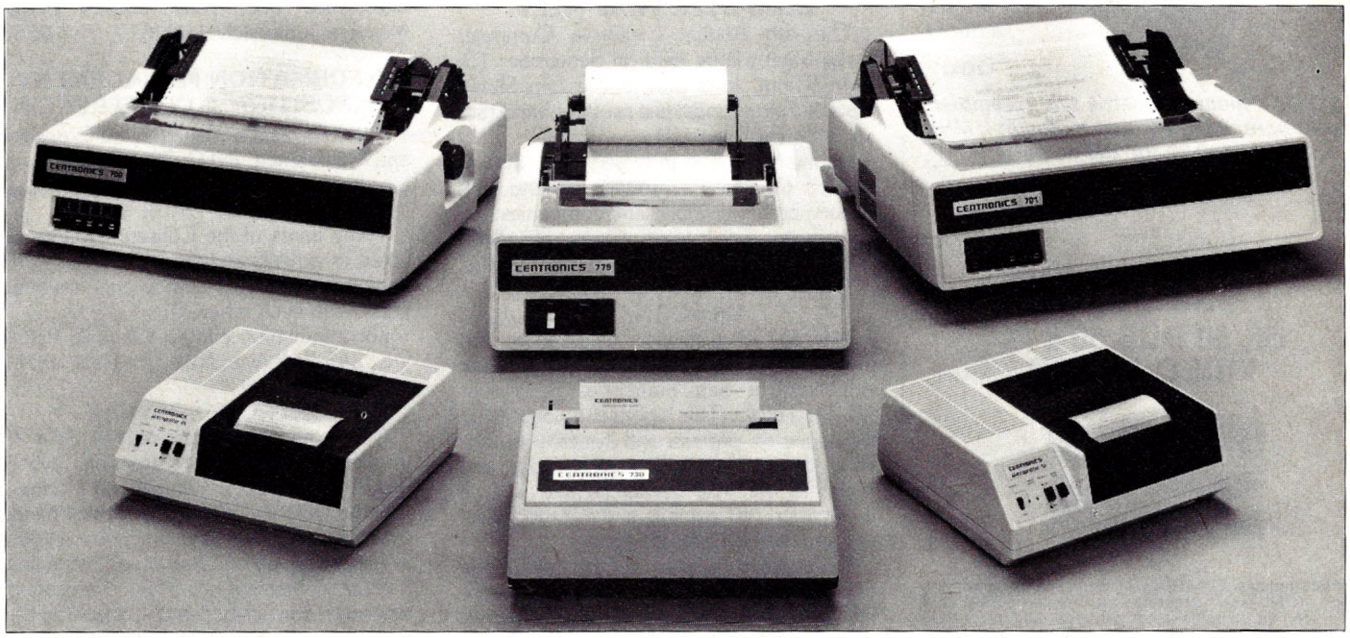
CONCLUSION

The law has a lot of catching up to do with regards to software. In the meantime, one can argue that some protection is better than none. While patent, copyright and trade secrets are methods of protection, copyright is gaining in popularity. Until the legal copyright software system is debugged, all one can do is render an educated guess. While copyrighting programs, consider copyrighting manuals, documentation, advertisements and directives and even using a registered trade name to further distinguish your work.

Finally, if software is to be marketed, consider utilizing a supplier/user contract or a supplier/purchaser contract, wherein the user or purchaser agrees not to provide, sell or re-sell the software to anyone else.☐

CENTRONICS DELIVERS THE WORD ON COMPUTER PRINTERS.

To get the most from a computer system, you need a permanent *written* record—information that you can use for reports, correspondence, or just about anything. For that, Centronics printers deliver the word.



From top left, clockwise: **Model 700** Impact printer, 60 cps, 132 column format. **Model 779** Impact printer, 60 cps, economical forms handling. **Model 701** Impact printer, 60 cps, bidirectional, 132 column format. **Model S1** Non-impact microprinter, RS-232 serial interface, 150 lpm. **Model 730** Impact printer, 50 cps, 3-in-1 paper handling. **Model P1** Non-impact microprinter, 150 lpm, no toners or ribbons.

Who is Centronics, anyway?

Centronics has long been the world leader in providing printers to the computer industry. For small, economical computer systems—like the ones at your local retail computer store—we manufacture more printers than anyone. That's quite a track record.

What does that mean to me?

If you own—or plan to purchase—a small business or home computer system, you can have the best printer available anywhere: Centronics. We offer the widest selection of speeds, sizes, applications, and prices. All interface with most mini and micro computer systems. Every model features the same performance, reliability, and attention to detail that have made Centronics #1. And every one is backed by Centronics' comprehensive warranty and service program.

Where can I find Centronics Printers?

At any of the hundreds of Centronics dealers coast-to-coast. It's worth the visit: your Centronics dealer is an expert who can explain the differences in printers and help make sure that the one you choose has the right features for your system and the way you use it. Plus, many of our dealers are also Authorized Centronics Service Distributors which is helpful when you need routine maintenance and a godsend if you have a problem.

Selection. Proven performance. Expertise. Service. That's why Centronics Printers deliver the word.

☐ Give me the word on Centronics Printers, including the name and address of the Authorized Centronics Dealer(s) nearest me.

☐ I'm interested in your dealer program. Please send information on how to become an Authorized Centronics Dealer/Service Distributor.

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CALENDAR

CANADIAN CONFERENCE

The Government Computer Conference will be held September 11-12 at the Chateau Laurier Hotel in Ottawa. The theme is "Policies, problems and the promise of Canada's information age."

For information contact Janet Glover, Whitsed Publishing Ltd., 2 Bloor St. West, Suite 2504, Toronto, Ontario M4W 3E2.

COMPUTER SWAP MEET

The 4th Annual California Computer Swap Meet will be held on September 15, from 9 a.m. to 5 p.m. at the San Mateo County Fairgrounds, just south of San Francisco on Highway 101.

Admission is free to buyers (with the exception of a $1 Fairgrounds parking fee). Sellers, both individuals and companies, are invited to call John Craig at (805) 735-1023 for booth prices and availability.

WESCON/79

Wescon/79 with its "Gateway to the Eighties" theme will hold its convention and exhibition in San Francisco, September 18-20, 1979. The high-technology event will focus on product and systems innovations designed to influence industry and home in the new decade. There will be more than 780 exhibits and 120 technical and professional presentations.

Professional sessions will be held at the St. Francis and Hyatt on Union Square Hotels. The exhibits will be at Civic Auditorium and Brooks Hall.

Wescon formally gets underway with a preview presentation on Monday, September 17, featuring an all-day marketing conference and the Keynote Address by Dr. John R. Pierce, Professor of Engineering at California Institute of Technology.

For details contact Wescon, 999 N. Sepulveda Blvd., El Segundo, CA 90245.

MINI/MICRO PROGRAMS AIM AT OEMS, USERS

A 24-session professional program has been outlined for the three-day Mini/Micro Computer Conference and Exposition in Anaheim Convention Center September 25-27. The programs are divided equally between sessions geared towards OEM suppliers and end users.

For more information contact Neil Kelley, Infosystems, Los Altos, CA, (415) 941-1920 or Robert Brown, Hewlett-Packard (DCD), Ft. Collins, CO, (303) 226-3800.

MIMI MONTREAL

The International Society of Mini and Microcomputers is sponsoring a forum for the presentation and discussion of recent advances in the application of mini and microcomputers. The theme of the conference is "The Evolving Role of Minis and Micros within Distributed Processing."

MIMI '79 will be held September 26 through 29 at the Queen Elizabeth Hotel in Montreal. For more information contact the Secretary, MIMI '79 Montreal, P.O. Box 2481, Anaheim, CA 92804.

MOUNTAIN STATES EXPO

Denver has been chosen as the site for the Mountain States Computer & Office Systems Expo, which will be held on October 10-11 at the Regency Inn.

The two-day event will include a program of exhibits and conferences which will be open to data processing and business professionals.

For information regarding exhibit sales or conference information contact Project Manager Judie McDaid at (617) 964-4550.

INFORMATION MANAGEMENT EXPOSITION & CONFERENCE

The Information Management Exposition and Conference, INFO 79, will occupy all four floors of the New York Coliseum when it convenes October 15-18.

Three floors of the Coliseum will be devoted to exhibits and the fourth floor to the conference, making both events easily accessible to each other.

For information contact Clapp & Poliak, Inc., 245 Park Ave., New York, NY 10017.

INTRO TO PASCAL

A seminar/workshop entitled "An Introduction to Pascal Programming," will be taught by Richard J. Cichelli and Martha J. Cichelli October 17-19. It includes hands-on Pascal programming workshop sessions as well as group and individual instruction.

Price for three days is $450. For more information contact Software Consulting Services, 901 Whittier Dr., Allentown, PA 18103, (215) 797-9690.

ACPA SOFTWARE TUTORIALS

The Association of Computer Programmers and Analysts (ACPA) will hold its Ninth Annual Conference October 22-24 in Washington, D.C.

Devoted to the theme of "Preparing Today for Tomorrow's New Technologies," the meeting will feature a full day of in-depth tutorials on transaction processing and controlling the database environment. Each tutorial session will present concepts and facilities of leading software packages along with practical experience in package applications.

For further information contact Ken Burroughs, DBD Systems, Inc., 1500 N. Beauregard St., Alexandria, VA 22311, (703) 820-3310.

GIDEP Conference

The Government-Industry Data Exchange Program (GIDEP) will have its annual conference and workshop on October 23-25 at the Harley Hotel, Orlando Florida.

For information call Dennis Starling, Datagraphix, Inc., Box 82449, San Diego, CA 92138, (714) 291-9960, Ext. 1266.

EIA SYMPOSIUM ON DEFENSE ELECTRONICS

A major national symposium on defense electronics in the 1980s will be held at the Jack Tar Hotel in San Francisco from October 23 through 25.

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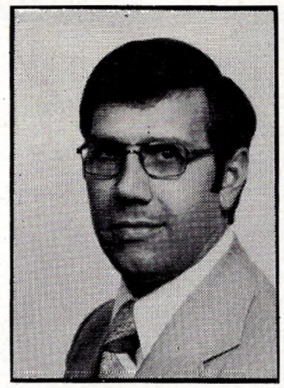

(TRS-80 PET APPLE II.)

Your microcomputer has the potential of paying you back a fantastic return on your investment by helping you make exceptional income property buys. This is the opinion of Virg Gering, a computer systems analyst and experienced real estate investor who developed the software to analyze income property.

"You can easily ***find investments which yield 100% increase in equity*** in the first year," claims Gering. "You can look at more property — and with a depth of analysis which is almost impossible by hand calculations."

"The income property analysis program was created by sheer necessity," Gering asserts. "As a beginning investor I was overwhelmed by the number of variables which must be taken into consideration when purchasing property.

I found myself limited to the number of properties which I could analyze because of the sheer volume of "pencil pushing" that was required. I then got the idea to feed this data into a computer and let it do the calculations for me. "This was a break-through!," exclaims Gering. "I was able to expand my search and analyze many more properties than would otherwise be possible by manual calculations."

"This is a ***dynamic tool for professional real estate people to demonstrate how income property investments really work***", says Gering. "There is a dire need for a vehicle of communication to explain in realistic and simplistic terms what cash flow, equity build-up and tax advantage are all about." The client can see how these categories change as you analyze various properties.

Gering points out how his program ***allows the user to restructure the offer*** again and again. "Each time a new offer is constructed, the computer will display a new analysis. By experimentation with the purchase price, down payment, trade equity, subordinate mortgage, interest rates, etc., the buyer has a ***powerful tool for optimizing the offer*** in his favor.

The user can investigate ***potential for remodeling and upgrading!*** He can experiment with various degrees of remodeling and projected rent schedules and instantly see the impact upon the cash flow, equity build-up, tax advantage, return on investment, etc.

You may also investigate the potential for ***conversion of a central heating system to individual heat!*** This is what Gering refers to as ***"taming the alligator."*** "With today's high energy costs it is becoming prohibitive to pay for someone elses heat. The analysis will show how profitable the conversion will be.

The modules for remodeling and heat conversion will help you find property which has been neglected but has a potential for dramatic improvement.

There are several features which cater to the novice investor. One example is the ability of the program to ***estimate the cost of monthly maintenance*** based upon age, number of units, average rent per unit, average square feet per unit and the type of construction.

You can also ***avoid the painful experience of an unexpected negative cash flow!*** "After a couple trips through this wringer you can certainly appreciate this feature."

The user may also ***view the payoff period of all mortgages.*** This includes any subordinate mortgages as well as new loans as a result of planned remodeling and/or heating system conversions. Gering also gives credence to those veterans who use "horseback estimates" by including the opportunity to see ***various Rule-of-thumb appraisals.*** Here are many of the favorite formulas which have been used over the years.

"One of the most satisfying aspects of this program is that it illustrates what ***'forced inflation'*** is all about," concludes Gering. "This is the single most important element for the investor who has the motivation to achieve a fortune in equity in a short period of time.

Virg Gering is a Computer Systems Analyst for a state university. He is also a Computer Systems Operations Officer for the Wash. Air National Guard. He holds an AS degree in Data Processing and a BA in Business. He has over ten years experience in systems and programming. He is also an experienced investor in income properties. In five years, in his spare time, he has progressed from a net worth of $6,000 to over $200,000. He points out that this achievement is certainly not spectacular — many people have accumulated over a million dollars in equity in the same period of time.

This software package is distributed by Aukland Associates. It sells for $62. This includes a documentation manual which explains the analysis and gives special insight and tips on investment strategy. It is available in cassette for the TRS-80, PET and APPLE II (BASIC II, 16K). If you are interested in this software but have a different computer, fill out the coupon (send no money) and you will be notified when available.

Please ship me the Income Property Analysis Software Package. Postpaid. Enclosed is check/money order/Bankcard # for $62. Wash. residents add **$3.10 tax.** Allow 3 weeks for delivery.

Specify: TRS-80 ☐; PET ☐; APPLE II ☐
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AUKLAND ASSOCIATES
Dept. N1, 2818 E. 19th Ave.,
Spokane, WA 99203

"Defense Electronics in the 80s: A Decade of Opportunity" will focus on trends in the defense electronics market during the next ten years, preview future issues and technology advances facing the defense establishment and provide an outlook on future congressional actions.

The symposium is sponsored by the Requirements Committee of the Electronic Industries Association's Government Division. For more details contact Frank Mitchell, (202) 457-4944.

ALBERTA COMPUTER ROUNDUP

The Western Computer Conference will be held October 17-18 at the Calgary Convention Centre, Calgary, Alberta.

Some of the session topic areas are: Distributed data processing in the natural resources industries; Growth of the OEM market in Canada's western provinces; Transborder data flows, national and international.

For details contact Janet Glover, Conference Coordinator, Whitsed Publishing Ltd., 2 Bloor St. W., #2504, Toronto, Ontario M4W 3E2, (416) 967-6200 or toll free across Canada at 1-800-268-7108.

MEASUREMENT SCIENCE CONFERENCE

The Measurement Science Conference Executive Board announces its Ninth Annual Conference will be held at the California Polytechnic State University, San Luis Obispo on November 30 and December 1.

The Annual MS Conference is dedicated to the fostering of the basic education of the professional metrologist and of providing the platform for the improvement of the metrologist's professional capablity.

For details write Mr. Leslie Carlton, Jr., c/o GIDEP Operations Ctr., Corona, CA 91720.

CHESS TOURNEY IN LONDON

The 2nd London Microprocessor Chess Tournament will be held in the West Centre Hotel, Lilee Road, Fulham, London from November 1-3. Any individual or company wishing further details should write to David Levy, c/o Personal Computer World, 62a Westbourne Grove, London, W2.

This year's event will be the first European Open Microprocessor championship. The highest placed participants will automatically qualify for places in the final of the first World Micro Championship which is scheduled to be held in 1980 in London.

SYSTEMS CONVERSION SYMPOSIUM

The DPMA Education Foundation will sponsor a major symposium on systems conversion November 13-15 in Washington D.C. The theme of the 3-day meeting is "Systems Enhancement — Converting Today's Systems to Tomorrow's Technology." Both the hardware and software aspects of computer conversion will be considered by experts in the field, along with conversion strategies and techniques.

For more information contact Ken Burroughs, Conference Chairman, DBD Systems, Inc., 1500 N. Beauregard St., Alexandria, VA 22311, (703) 820-3310.

CIRCLE INQUIRY NO. 20

From the Fountainhead

By Adam Osborne

After visiting the National Computer Conference last June, I was struck by the speed with which the microcomputer and minicomputer marketplaces are merging. Most microcomputer manufacturers were exhibiting in the "Personal Computing" exposition at the Sheraton Hotel, while minicomputer manufacturers remained on the main floors at the convention center. But many microcomputer manufacturers had migrated to the main floor, while some of the exhibitors in the "Personal Computing" exposition were well-known industry manufacturers.

There was nothing "personal" about the exhibitors or the exhibits in the "Personal Computing" section at the Sheraton Hotel. Minicomputer and microcomputer manufacturers are rapidly merging into a single industry, with competing products that appeal to the same customer base. Microcomputer manufacturers still offer less expensive and less capable computer systems than do minicomputer manufacturers, but a significant overlap has already developed between "high-end" products of the microcomputer marketplace and "low-end" products of the minicomputer marketplace.

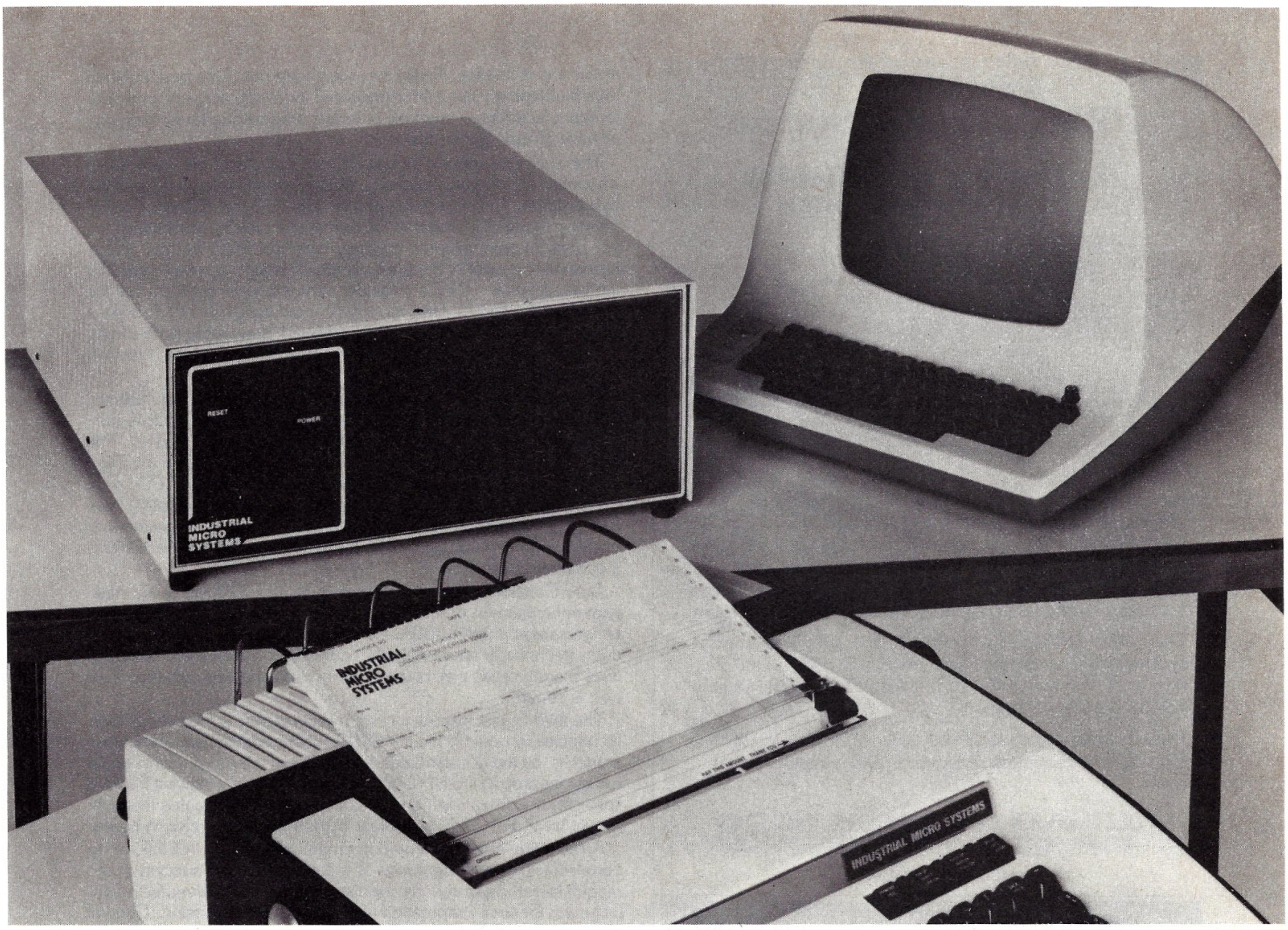
Within a couple of years microcomputer manufacturers will be offering CPUs built around the new generation of 16-bit microprocessors — the 8086 and the Z8000; their systems will include large capacity hard disks among a full range of peripherals. Then there will be little or no difference between a microcomputer system and a minicomputer system. You will call a system a "microcomputer" or "minicomputer" because the manufacturer says so, not on the basis of any performance criteria.

The most interesting aspect of the microcomputer and minicomputer industries is, perhaps, historical. There are so many parallels between the emergence of these two markets; and at the same time, there are some critically important differences. By analyzing the way in which these two industries emerged, we can focus more clearly on the problems of product quality which bedevil the microcomputer industry today.

Many participants in the new microcomputer industry — manufacturers and customers — were not around ten years ago, and therefore do not see the close parallels between today's mushrooming microcomputing industry and the minicomputer industry which exploded out of nowhere, with equal vigor, ten years ago. The minicomputer industry also began with hundreds of companies peddling computers. The weakest were trash, the best quite acceptable.

Like today's microcomputer industry, minicomputer manufacturers first went into business with CPU boxes supported by virtually no peripherals, very little software, and documentation which could be described politely as disgusting. Like today's microcomputer manufacturers, minicomputer builders established markets for themselves, despite the shortcomings of their products, because no one else offered anything better at comparable prices. The early bad actors of the minicomputer industry had perhaps five years in which to get their act together and survive. Many did not.

Large companies, such as Raytheon and Westinghouse, made forays into the minicomputer market before withdrawing ignominiously to lick their wounds. Wang Laboratories, who today does so well in the computer market, had a disastrous beginning with its first minicomputer, the Wang 3300. And then there were companies who vanished into bankruptcy or were absorbed in acquisitions just prior to disappearing. Many companies were run into oblivion by management who could build hardware, but knew nothing about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marketing or finance. Today they are ghosts out of the past, but they look frighteningly like mirror images of today's typical microcomputer manufacturers — so many of whom are heading for bankruptcy, or have already gotten there.

The survivors among minicomputer manufacturers were those who knew how to run a business, not necessarily those who built the best product. Today's minicomputer leader, Digital Equipment Corporation (generally known as DEC) manufactures systems which are not always competitive on a purely technical level, but are always formidable because of the service and customer support provided by the manufacturer. DEC's principal minicomputer products are the PDP-8 and PDP-11 families. Intersil now builds the PDP-8 on a single chip (the IM 6100); and the PDP-11 is available (with sundry enhancements and variations) from Alpha Micro Systems, Heathkit and Digital Micro Systems.

Data General, the second largest minicomputer manufacturer, built the company on the NOVA minicomputer line; by today's standards, the NOVA is a hokey enhancement of the PDP-8. The NOVA could not begin to compete with the Intel 8086 or the Zilog Z8000. Data General and Fairchild both offer NOVA CPUs on a single chip (the microNOVA from Data General and the 9440 from Fairchild) but neither is doing a particularly vigorous business in microcomputer chips since neither the microNOVA nor the 9440 is a competitive product.

Data General's "super" minicomputer, the Eclipse, is an inelegant enhancement of the NOVA, much as the Z80 is an inelegant enhancement of the 8080A. Yet despite the relatively crummy products (technically speaking) offered by Data General, the company does magnificently well because their marketing and customer support is superb.

The third largest manufacturer of minicomputers is Hewlett-Packard. Its principal product is the HP 2100, whose architecture and performance is, by today's standards, a joke. Many microprocessors could run circles around the HP 2100; yet the magnificent Hewlett-Packard software, documentation and customer support guarantee the technically weak HP 2100 a resilient market for many years to come.

Among the lesser minicomputer manufacturers we see little or no correlation between the power of a product and the success of the manufacturer. Take the two similarly named minicomputer manufacturers: General Automation and Computer Automation. General Automation built its company on the SPC-16 minicomputer product line while Computer Automation relied on its Alpha 16. General Automation's SPC-16 is a truly powerful minicomputer, technically way ahead of DEC, Data General or Hewlett-Packard. Computer Automation's Alpha 16 is, at best, inferior and archaic.

Based on technical performance, General Automation should be the number one minicomputer manufacturer, while Computer Automation, along with Hewlett-Packard, should be struggling somewhere at the back of the path. In fact, Computer Automation and General Automation are both second-rate minicomputer manufacturers, of about equal size and profitability.

But if you compare the limited customer service and support offered by General Automation and Computer Automation with the extensive customer service and support offered by DEC, Data General or Hewlett-Packard, the relative market positions of these companies make a whole lot of sense. Thus we can conclude that the technical merits of minicomputer manufacturers' products have had very little influence on the success of the minicomputer manufacturer. Success or failure has depended almost entirely on the quality of a company's marketing, customer service and support.

But there are also some profound differences between today's microcomputer industry and yesterday's minicomputer industry, in their emerging years.

Minicomputer manufacturers got started in the mid to late 60's, during the heyday of venture capital. A funny story of the time stated that anyone who walked into the middle of Wall Street and shouted "Minicomputer!" would be buried up to the neck in money. (This story had more truth than poetry to it.)

Indeed, venture capitalists gave hundreds of thousands or even millions of dollars to new enterprises which, by today's standards, would be considered dubious at best. I have heard many entrepreneurs of the 60's reminisce with nostalgia about how they raised half a million dollars within a few weeks to support an idea that had not even gotten off the ground and was described in a ten-page typed summary.

In contrast, today's microcomputer manufacturers stand no

chances of raising any venture capital until they have already established themselves. Even at that point, they must pay dearly for any money they get. Why? Because today healthy companies are valued at eight times post-tax earnings, while unhealthy ones are offered a whole lot less than that. In the late 60's companies were frequently valued at more than twenty times annual post-tax earnings.

Another major difference between the mini and microcomputer industries results from prices and volumes. Minicomputer manufacturers, when they went into business ten years ago, sold small computer systems at prices ranging from $20,000 to $250,000; and if they sold a few hundred systems a year, they were doing just fine. Radio Shack and Texas Instruments could not get excited by those numbers. Therefore, minicomputer manufacturers did not have to face the same formidable competitors confronting today's microcomputer manufacturers.

Today's microcomputer manufacturers are operating in a much tougher and less forgiving environment than yesterday's minicomputer manufacturers. In consequence, today's microcomputer manufacturers will have fewer chances to make mistakes and less time to put their houses in order. Radio Shack and Commodore were relatively late entries into the microcomputer marketplace, yet they totally dominate it today.

Texas Instruments and Atari are just making their moves today; are they too late? I think not. Most of the early manufacturers did not use their early entry to consolidate a position for themselves. Rather they used their early entry to antagonize the entire microcomputer marketplace, and guarantee a customer base for the more solid manufacturers who appeared later. How often I have heard customer sentiments epitomized by the statement: "That SOB! I buy their products because I have no alternative. But wait til they have competition. I will buy from their competitors just to get back at them."

This is a message that seems to be totally lost on the majority of companies operating in the microcomputer market — hardware and software companies alike. The ignorance of today's microcomputer industry hardware and software companies is most evident when you look at the ambitious plans they make for their products, and the flagrant overuse, bordering on abuse, of hardware. Floppy disks are used in applications that would tax a hard disk; systems which have no back-up are being used in applications where reliability is a critical factor. The surest sign that the company does not understand what they are doing is when they use hardware beyond its capabilities.

On the subject of hardware capabilities, I was perhaps a little harsh in a recent column when I criticized Nestar for offering a pair of floppy disk drives that could be accessed by a large number of microcomputers. I criticized this product for misusing the limited resources of floppy disk drives. What I did not know (because Nestar never advertised the fact) was that this floppy disk system was soon to be replaced by a large capacity hard disk system; and that makes a lot of sense. I still feel Nestar should not have offered their floppy disk product, but their hard disk multi-terminal system looks very attractive, and their product support is excellent.

I urge customers to start being very critical when it comes to evaluating products before buying. The days are over when you have to buy junk because nothing else is around. Quality hardware and software is beginning to appear; and you have every right to demand it. Check into the financial health of the company whose product you are going to buy. Make sure that hardware is not overused and that software is not being oversold. Buy products, not promises.

Most important of all, do not buy products based on a technical evaluation of capabilities. History has proven this to be an almost irrelevant criterion on which to base your selection. Do not worry about product obsolescence. As an end user, you should feel far more comfortable buying a system whose every component has been on the market two or three years. Remember: "He who buys on the cutting edge of technology shall be sacrificed upon it."

Base your product selection on the ability of what you buy to solve the problem which you need solved. If the hardware and software you buy is capable of solving your problem, then anything more is irrelevant. Base your selection on the ability of the vendor to give you whatever support you feel you need. But do not expect such support to be free. You get what you pay for; support offered at no charge usually finishes up being no support.□

The views in this column are those of the author and are not necessarily those of the magazine or its staff. Dr. Osborne may be contacted at P.O. Box 2036, Berkeley, CA 94702.

With these five disks, I can turn your TRS-80 into a serious computer.

My name is Irwin Taranto, and I know what I'm talking about.

I've been making computers work ever since they had vacuum tubes in them, and I've put the first computer into more than 300 different businesses.

Over the years, I've learned a few things.

For instance, I've learned that the new microcomputers like the TRS-80 are really elegant pieces of hardware. The price is deceiving. Given the right programs, they can jump through hoops.

But finding the right programs isn't all that easy. You can flip through the pages of this magazine and find 50 ads for TRS-80 programs. Granted, a good many of them are for fun and games, but you can still find quite a few offering business programs.

They aren't like mine, though.

Four of these are the genuine Osborne & Associates systems, originally designed for the $30,000 Wang computer. I've made a few minor modifications on them, and now they work on a $4000 TRS-80. The fifth program is one I added myself.

Here's what's on each disk:

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Inventory Control: a custom-tailored program that looks after up to 20 sizes of each of 1300 items — a million items in all. It gives an immediate readout on any item inquiry, including quantity and dollar total.

These programs are marvels of efficiency. They're fully-documented, and you can buy the books locally or from me. On the Osborne programs, my contribution was simply this: I made them work on the TRS-80, and if you buy them from me, I'll make them work for you.

If you're skeptical on that point, call the number below and we'll give you the names of some of the people who've already bought all over the world. Then you can call them up and hear what they have to say.

These programs only cost $99.95 each. (The Cash Journal option on the General Ledger adds another $50.) For that you get the disk, all the instructions you need, and my telephone number. If you call, we answer all your questions and make sure everything's working smoothly. If your question's tough enough, I'll talk to you personally.

Because, as I said, I plan to turn that TRS-80 of yours into a serious computer.

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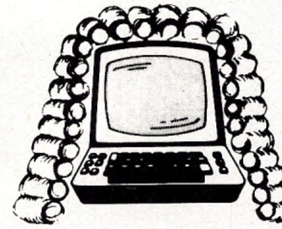

By Leonard Tachner
Attorney-at-Law

TRADEMARKS — PART 3

There are three different situations in which trademark disputes arise. In general terms, these may be categorized as follows: (1) disputes relating to the registration of marks that arise between two or more parties; (2) disputes that arise between a party seeking registration and a trademark registering agency such as the United States Patent and Trademark Office; and (3) disputes that arise between parties and involve litigation or the threat of litigation.

Category 1

Disputes in this category involve situations in which one or both parties is seeking either registration of his trademark or a limitation or cancellation of the other party's previous registration. Such disputes typically arise in the United States Patent and Trademark Office where federal registration of a trademark is involved. The states generally do not have equivalent proceedings because state registration is a relatively informal process. However, state laws usually provide for cancellation of previously registered marks by order of a state court of competent jurisdiction.

Disputes in this category that arise in the U.S. Patent and Trademark Office are referred to as opposition proceedings, cancellation proceedings, concurrent use proceedings and interference proceedings.

After an application to register a trademark in the U.S. Patent and Trademark Office has been approved by a trademark examiner, the trademark and notice of its impending registration are published in the weekly official *Trademark Gazette* of the United States Patent and Trademark Office. Publications for opposition, in addition to showing the mark, also indicate the goods or services with which the mark is used and the date of alleged first use.

Anyone who wishes to oppose the registration and believes he has grounds to do so must file his opposition, or a request for an extension of time, within thirty days from the publication date of the Official Gazette in which the mark appeared. Any person who believes that he is likely to be damaged by registration of the mark has legal standing to oppose its registration and will prevail in the opposition if he can show that there are valid grounds for refusing the registration.

Such grounds may be a legal defect or deficiency in the application or ownership of a prior registration of a confusingly similar mark or merely the opposer's priority use of a trademark which the public is likely to confuse with the mark for which federal registration is being sought.

If someone misses the opportunity to oppose the registration by failing to act within the thirty day period from the time the mark is published for opposition, he may still take the opportunity to initiate cancellation proceedings. For marks that have been registered for less than five years, the legal standing and grounds for alleging that a registration should be cancelled are about the same as they are for opposing prior to its registration.

However, after a mark has been registered for a five-year period, the grounds upon which a petition to cancel may be based are substantially narrowed under the federal law. Of course, it must be kept in mind that a successful opposition or cancellation proceeding affects only a mark's registration and has no bearing upon the common-law rights in a trademark.

Concurrent use proceedings involve the concept of issuing registrations to two parties who have been using confusingly similar trademarks in distinct geographical sections of the nation. Typically, the prior user obtains nationwide registration with the exception of those areas of the country in which the second user of the mark has

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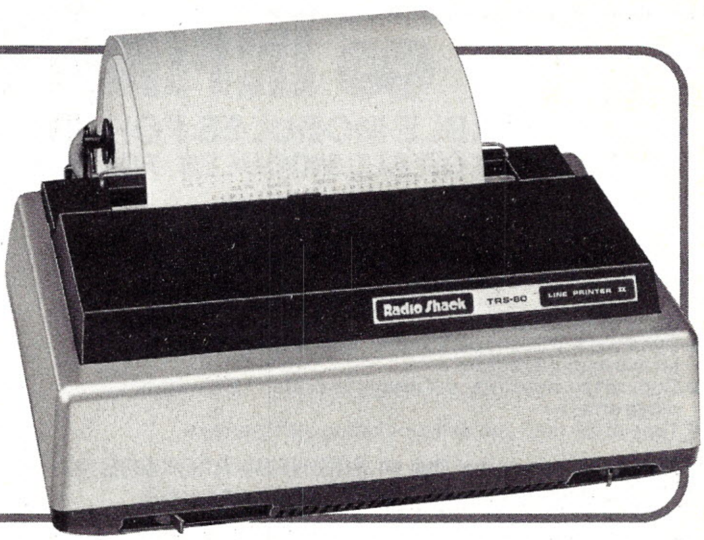

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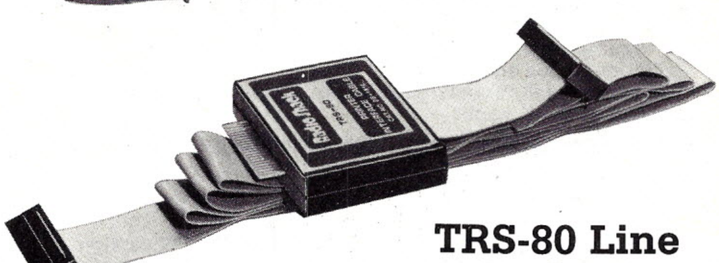

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already established common-law rights through actual use or a strong probability of use. A concurrent use proceeding is most likely to result in such split geographical registrations where it is the second user who first obtains federal registration and the prior user who institutes concurrent use proceedings to also obtain federal registration.

The courts have indicated that because there should be a policy of rewarding those who first seek federal registration, the second user may be awarded his area of actual use as well as the rest of the nation not already exposed to use by the senior party. Sometimes the courts and Trademark Office will recognize a geographical split of registration according to an agreement between the parties if such agreements are made in good faith and are not likely to result in confusion, mistake or deception.

Interference proceedings are applicable whenever an application is made for the registration of a mark which so resembles a mark previously registered by another, or for which another has previously applied for registration, as to be likely when applied to the goods or when used in connection with the services of the applicant to cause confusion or mistake or to deceive.

However, because of the availability of opposition and cancellation proceedings, interference proceedings have become rare and are used only in those instances in which a party is able to prove that he will suffer irrevocable harm if his only recourse is to file an opposition or petition for cancellation.

In an interference proceeding the second party to file an application to register a trademark has the burden of proving that he is entitled to registration of the mark because he has prior use of the mark. Usually, whoever can prove that he is the senior user of the mark is granted the registration if there is a likelihood of confusion between the two marks.

Of course, if the Trademark Office finds that there is no likelihood of confusion, both parties may be allowed to register their respective marks. Both parties may also be refused registration of their trademarks.

Disputes between parties in the U.S. Patent and Trademark Office are administered by the office's Trademark Trial and Appeal Board in Washington, D.C. However, unlike civil trials in federal and state courts, all testimony is taken by deposition; that is, testimony taken under oath before a court reporter anywhere in the country and submitted to the board for consideration. In addition, relevant documents may also be submitted.

Finally, the attorneys for the respective parties submit trial briefs setting forth their arguments based upon the evidence submitted. An oral hearing is also permitted if desired by either side. Thus, for the most part such disputes are tried by deposition and the result is determined substantially through correspondence with the attorneys of the respective parties.

Category 2

Disputes in this category, known as ex parte proceedings, arise when a trademark owner is denied registration of his trademark and he believes that registration should have been granted. Although no formal procedure exists in most states for appealing a registration denial, it is feasible to bring suit against the state administering body responsible for denying the application to register a trademark, and asking a court to issue an order requiring registration of the trademark.

However, such suits are extremely unlikely because of the expense involved compared to the advantages of state registration and the availability of federal registration for those users who have met the interstate commerce requirement discussed in previous parts of this series.

As an intermediate step it is possible to petition the State Attorney General's office to seek an official opinion in situations where it is believed that the trademark State Agency has misinterpreted the state law in denying the registration.

In the United States Patent and Trademark Office, denial of an application to register a trademark will first come from the trademark examiner. Denial is most often based on the allegation that the mark for which registration is sought would likely result in public confusion, mistake or deception because of a previously registered mark.

Whatever the reason for the rejection, the applicant may appeal within the United States Patent and Trademark Office to the Trademark Trial and Appeal Board. If the board affirms the examiner's rejection of the application to register, the applicant may then appeal

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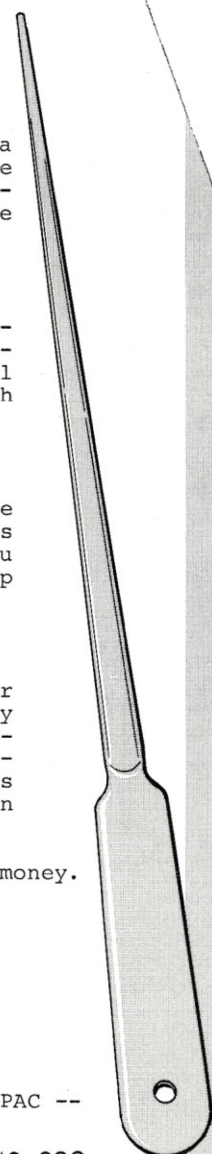

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outside the Patent and Trademark Office in specified federal courts. He may ultimately seek review in the U.S. Supreme Court, although this is highly unlikely.

Category 3

Disputes in this category arise when the owner of a trademark believes that another party is infringing his trademark rights. Those trademark rights might be only common-law rights which arise by mere use of the mark on products or services. On the other hand, they may also include expanded rights under either state or federal registration. Frequently such disputes begin with a letter from the trademark owner's attorney to the alleged infringer demanding immediate cessation of use and threatening a lawsuit if the alleged infringer does not agree to immediately cease use of the mark.

Frequently such threatening letters also include an allegation of unfair competition and, if appropriate, also indicate with a copy of the registration certificate that a trademark is registered in the United States Patent and Trademark Office or with one or more states.

Depending upon the size of the business entities involved and the available resources for the expense involved in a trademark lawsuit, the parties will usually first attempt to resolve the matter through correspondence between their attorneys. Of course, resolution of the matter will depend upon the restrictive opinions regarding whether or not an actual infringement exists, the question of who has priority of use of the trademarks involved, and the extent to which each party has already invested in developing the popularity of the trademark through extensive advertising and the like.

If neither party is prepared to give any ground outside the courtroom, either one may be in a position to initiate a lawsuit. The potential defendant in the trademark infringement matter may file an action for declaratory judgement asking the court to determine the rights of the respective parties and resolve the matter in his favor by finding either that there is no infringement or that the trademark rights of the other party are invalid or otherwise inappropriate to assert against the defendant.

Of course, the trademark owner who originally made the litigation threat may also file suit for an action under unfair competition and trademark infringement laws in either state or federal court. The jurisdiction of the court is determined by whether or not the allegedly infringed mark is federally registered or upon whether the parties are residents of different states and the matter involves more than $10,000 in damages.

The plaintiff in a trademark infringement suit will usually seek an injunction to prevent the defendant from continuing the allegedly infringing acts and will also seek monetary damages for the defendant's past allegedly infringing acts. Under federal law the plaintiff's damages may be measured by the profits lost as a result of the infringement and/or the profits earned by the defendant because of the infringement.

In addition, federal law gives the Federal District Court discretion to increase damages up to three or more times actual damages where it can be shown that the defendant was guilty of wanton misconduct. The courts have also allowed recovery of attorney fees in exceptional situations.

If a federally registered mark is involved in the lawsuit, the federal courts have the power to order cancellation of the registration if, for example, a defendant charged with infringement of a registered mark successfully counterclaims for cancellation of that mark. Typically, the state courts have the same power with regard to state registration.

Federal law also provides an alternative remedy to trademark registrants whose trademarks are being infringed by someone importing goods into the United States bearing an allegedly infringing mark. This alternative remedy is available to owners of trademarks registered on the Principal Register in the United States Patent and Trademark Office and provides for prevention of importation of the goods by their seizure and forfeiture.

A separate federal law, under the so-called Tariff Act, sets up a procedure by which the United States owner of a common-law trademark may also instigate seizure of imported goods bearing an allegedly infringing mark.☐

The material presented in this column is intended for the reader's general information. The author requests that the reader consult professional advisors prior to applying this material to his or her specific situation. Anyone seeking further information may contact the author at the law firm of Fischer and Tachner, 2192 Dupont Drive, Suite 210, Irvine, CA 92715.

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THE MICRO-MATHEMATICIAN

By Dr. Alfred Adler

Considerable mail has arrived since this column started in February and we are happy to report that it has been, with one exception, highly favorable. We have a reader in Australia who would like more REMs in the programs (we have to agree); hates multiline statements (they do save RAM and time and are not that confusing if confined to !, NEXT, K=K+1, GOTO, etc.); and wishes us to point out that the backslash is the delimiter used in a multiline statement by Poly BASIC, as opposed to the far more common semicolon.

A reader in Massachusetts is interested in microcomputers as an educational tool and sent several very interesting and useful programs which are being featured in this month's column. He is also a Poly user and has acquainted us with Discovery Bay Software. He says that have an editor that attaches to Poly BASIC that "is a real jewel"; also that they put out a journal from time to time with helpful hints such as a fix for a bug in Poly A00's LOG function.

He has sent us a modification to Poly BASIC with a patch that reduces the number of nulls recorded, thus cutting 35% from the SAVEing and LOADing time. Now that's worth having!

For those of you who might want to contact the author of this month's programs, he is the Rev. Walter L. Pragnell, 9 Warren St., Everett, MA 02149. Anyone interested in what Discovery Bay Software may have to offer can reach them at P.O. Box 464, Port Townsend, WA 98368.

We realize there may be many readers put off by the column listings printed in Poly BASIC, since it is not quite the most widely used interpreter. However, we have been trying since January to get our North Star disk system running without a whole lot of success. There have been a few problems between Tucson and Berkeley, but hopefully they will be resolved soon and after that all listings will be in North Star BASIC.

FACTORIALS REVISITED

In the April column factorials were discussed and a program was presented that generates factorials of numbers less than 50. Since $49! = 6 \times 10^{62}$ it would appear that higher limits would not ordinarily be necessary. For anyone who needs factorials of higher numbers or who needs answers to more than eight digits (exact answers, in fact), the first two of Rev. Pragnell's programs should prove interesting.

The first of these programs, Program N!, computes factorials exactly, digit for digit, up to some very large numbers. As sent to us, the program worked well on a screen but insisted on using the full platen width on the HyType, even though we were using 8½-inch paper. We took the liberty of adding statements 17 and 44, which took care of that problem nicely. A sample run is shown after the listing. The generation of 50! took about 15 to 20 seconds with a Poly CPU board.

The second program, BIG-N!, generates factorials of large numbers by adding the logarithms of their factors. As noted in the introduction to the program, it is extremely fast, computing 1000! in 140 seconds. In an application where factorials of numbers no larger than 49 are required, the routine in FACTHYP presented in the April column would be best since it runs faster than BIG-N! by a factor of ten. However, if factorials of numbers greater than 49 might possibly be needed, by all means the routine in BIG-N! should be used.

MATRICES

The third of Reverend Pragnell's programs is a real beauty. Program MATDEMO is a tutorial on matrices, yielding addition, multi-

plication, transposition, and inversion of matrices up to 9 × 9. This month we will discuss addition, multiplication, and transposition of matrices, leaving inversion for a later time.

At first glance a matrix, if it is square, looks somewhat like a determinant. However, they are quite different. A determinant is a number (it looks like lots of numbers, but when reduced it is simply a single number), whereas a matrix is a two-dimensional array of numbers. How the array is used is up to you. Matrix methods in mathematics are very appealing since they provide a very compact notation useful in linear transformations or in the solution of systems of equations. They also provide a readily identifiable pattern which carries through the solution and makes error spotting much easier. As a means of getting involved in matrix methods, let us review some of the rules of matrix algebra.

Addition of matrices is accomplished by simply adding each element of the first matrix to the corresponding element of the second matrix. For example, suppose we define the following matrices A and B, and add them to form matrix C.

$$\text{matrix } A = \begin{bmatrix} 1 & -2 & 3 \\ -4 & 5 & 6 \end{bmatrix} \qquad \text{matrix } B = \begin{bmatrix} 7 & 8 & -9 \\ 10 & -11 & 12 \end{bmatrix}$$

Before adding, let us define the matrix elements so we can talk about them more easily. An element of matrix A will be referred to as a_{ij} where subscript i is the number of the row in which the element lies, and the subscript j is the number of the column in which the element lies. Thus $a_{11}=1$, $a_{12}=-2$, $a_{13}=3$, $a_{21}=-4$, $a_{22}=5$, and $a_{23}=6$. Similarly for B. Now the addition rule can be stated more concisely as $c_{ij} = a_{ij} + b_{ij}$, where $i = 1,2$ and $j = 1,2,3$. Carrying this out

$$\begin{aligned}
c_{11} &= a_{11} + b_{11} = 1 + 7 = 8 \\
c_{12} &= a_{12} + b_{12} = -2 + 8 = 6 \\
c_{13} &= a_{13} + b_{13} = 3 - 9 = -6 \\
c_{21} &= a_{21} + b_{21} = -4 + 10 = 6 \\
c_{22} &= a_{22} + b_{22} = 5 - 11 = -6 \\
c_{23} &= a_{23} + b_{23} = 6 + 12 = 18
\end{aligned}$$

Writing this in matrix form we get

$$C = \begin{bmatrix} 8 & 6 & -6 \\ 6 & -6 & 18 \end{bmatrix}$$

Obviously, the matrices to be added must each have the same number of rows and the same number of columns.

Multiplication of matrices is a bit more involved. In order to multiply matrices we must multiply rows by columns. The first row, first column element of the product matrix is the sum of the products obtained by multiplying each successive element of the first row of the multiplier matrix by the corresponding element in the first column of the multiplicand matrix. This process continues until the elements of every row of the multiplier have been multiplied by the elements of every column of the multiplicand. For example, suppose

$$A = \begin{bmatrix} 1 & 2 & -3 \\ 4 & -5 & 6 \end{bmatrix} \qquad B = \begin{bmatrix} 9 & -8 \\ 4 & 6 \\ -7 & 2 \end{bmatrix}$$

Using the element notation developed in the discussion of matrix addition, we note that matrix A is composed of elements a_{ij} where $i = 1,2$ and $j = 1,2,3$ whereas matrix B is composed of elements b_{jk} where $j = 1,2,3$ and $k = 1,2$. In other words, A has 2 rows and 3 columns, but B has 3 rows and 2 columns. The importance of this will become more apparent as we proceed.

The change in notation in matrix B from row i and column j to row j and column k was necessary to conform with summation conventions. We must not confuse the rows and columns of A with those of B. It was permissible in the case of addition, but would lead to total confusion in the case of multiplication. The important thing to remember is that the first subscript is always the row number of the corresponding matrix and the second subscript is always the column number of that same matrix.

Using the rule for multiplication stated above and letting matrix C be the product matrix, we obtain

$$\begin{aligned}
c_{11} &= a_{11}b_{11} + a_{12}b_{21} + a_{13}b_{31} = 1 \times 9 + 2 \times 4 + (-3) \times (-7) = 38 \\
c_{12} &= a_{11}b_{12} + a_{12}b_{22} + a_{13}b_{32} = 1 \times (-8) + 2 \times 6 + (-3) \times 2 = -2 \\
c_{21} &= a_{21}b_{11} + a_{22}b_{21} + a_{23}b_{31} = 4 \times 9 + (-5) \times 4 + 6 \times (-7) = -26 \\
c_{22} &= a_{21}b_{12} + a_{22}b_{22} + a_{23}b_{32} = 4 \times (-8) + (-5) \times 6 + 6 \times 2 = -50
\end{aligned}$$

The reader will recall that in the very beginning of the discussion of matrices it was pointed out that a readily identifiable pattern is always present. Examination of the above equations for c_{ik} reveals the following patterns. In each of the equations, the first subscript on the a's and the second subscript on the b's remain the same and are the same as the subscripts on the c. Further, the second subscript on the a's and the first subscript on the b's are the same in each term and successively are 1 in the first term, 2 in the second term, and 3 in the third term.

Thus the rule for matrix multiplication can now be stated more concisely as $c_{ik} = a_{ij}b_{jk}$ where $j = 1,2,3$. Note that i is the row number of the product matrix and k is the column number and that j disappears during the summation process. It should be apparent to the careful reader that what is being examined is only the tip of the iceberg.

Note that in order to multiply two matrices they must be "conformable." That is, the number of columns in the left hand matrix must equal the number of rows in the right hand matrix. The product will have as many rows as the left hand matrix and as many columns as the right hand matrix. This, of course, is a direct consequence of the summation rules.

It should further be noted that some of the laws of algebra that are learned in the early years are not true for matrices. For example, in matrix multiplication it is not true that AB = BA. Using the matrices already defined

$$AB = C = \begin{bmatrix} 38 & -2 \\ -26 & -50 \end{bmatrix}$$

However, it should be verified by the reader that

$$BA = D = \begin{bmatrix} -23 & 58 & -75 \\ 28 & -22 & 24 \\ 1 & -24 & 33 \end{bmatrix}$$

It is also not true in matrix multiplication that if XY = 0, then either X = 0 or Y = 0. For example, let

$$X = \begin{bmatrix} 1 & 1 \\ 2 & 2 \end{bmatrix} \qquad Y = \begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}$$

Then, even though $X \neq 0$ and $Y \neq 0$,

$$XY = Z = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

Transposition by itself is a rather simple operation. To transpose a matrix you merely interchange the rows and columns. Thus to transpose the matrix C above, convert rows to columns and columns to rows and obtain

$$C^T = \begin{bmatrix} 38 & -26 \\ -2 & -50 \end{bmatrix}$$

An interesting relationship exists between multiplication and transposition as follows. As was pointed out earlier $AB \neq BA$. In fact, unless A and B are both "square" (having the same number of rows and columns), the product AB will not have the same size and shape as BA. Further, although A and B may be conformable in that order, they may not be conformable in reverse order.

Therefore, although AB may exist, BA may not exist. However, if AB = C, it can be shown that $B^TA^T = C^T$. In other words, if at the same time that we reverse the order of A and B, we transpose them both, we resolve the problem of conformability and instead of the product being C it becomes C^T.

A discussion of matrix inversion, linear transformation, and the use of matrices in the solution of systems of equations will be taken up in the future. Meanwhile, the interested reader should compose practice problems and use Program MATDEMO to check the answers.□

Programs Follow

Alfred Adler can be contacted at 10360 Flintlock Trail, Tucson, Arizona 85715.

LISTING 1

```
>>LIST              Program BIG-N!
10 REM--By the Rev'd Walter L. Pragnell, Everett MA 02149
20 !"THIS PROGRAM CAN COMPUTE FACTORIALS OF LARGE NUMBERS."
30 !"Few computers calculate factorials of numbers as large as"
40 !"70 even approximately, because they cannot handle the"
50 !"resulting huge numbers. For example, 70! is approximately"
60 !"equal to 1.2 x 10 ^ 100; that is, 12 followed by 99"
70 !"zeroes."
80 !"This program will calculate 1000! in about 140 seconds,"
90 !"and has been used to calculate 10,000! (which is about"
100 !"equal to 2.85759 x 10 ^ 35659, or 29 followed by 35,658"
110 !"zeroes). It prints 6 significant figures, rounded."\!
120 !"When requested, please enter the value of the number of"
130 !"which you want the factorial. After calculating it, the"
140 !"program will ask for other numbers as long as you wish."
150 D=LOG(10)
160 !\INPUT"Enter N: ",N
170 IF N<0 THEN 180 ELSE 200
180 !"Factorials of negative numbers are not defined."
190 GOTO 160
200 IF N=INT(N) THEN 210 ELSE !"Integers only."\GOTO 160
210 Y=0
220 FOR J=1 TO N\Y=Y+LOG(J)/D\NEXT
230 !"N! =",%7F5,10^(Y-INT(Y))," x 10 ^",%#,INT(Y)
240 !
250 GOTO 160
>>
>>
>>RUN

THIS PROGRAM CAN COMPUTE FACTORIALS OF LARGE NUMBERS.
Few computers calculate factorials of numbers as large as
70 even approximately, because they cannot handle the
resulting huge numbers. For example, 70! is approximately
equal to 1.2 x 10 ^ 100; that is, 12 followed by 99
zeroes.
This program will calculate 1000! in about 140 seconds,
and has been used to calculate 10,000! (which is about
equal to 2.85759 x 10 ^ 35659, or 29 followed by 35,658
zeroes). It prints 6 significant figures, rounded.

When requested, please enter the value of the number of
which you want the factorial. After calculating it, the
program will ask for other numbers as long as you wish.

Enter N: 50
N! =3.04143 x 10 ^ 64


Enter N: 100
N! =9.33254 x 10 ^ 157


Enter N:
```

Programs Continue

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LISTING 2

```
>LIST                Program MATDEMO
1 REM: By the Rev'd Walter L. Pragnell; 9 Warren Street;
2 REM: Everett, MA 02149. April 23, 1979.
3 DIM A(10,10),B(10,10),C(10,10)\R$=CHR$(12)\S$=" "
4 DIM I1(10),J1(10)
5 !R$,TAB(7),
6 !"THIS IS A TUTORIAL PROGRAM ON MATRIX MATHEMATICS."\!
7 !"It will handle matrices up to 9x9 for most cases."\!
8 !"Please type the number of the operation in which you"
9 !"are interested, as displayed on this `menu.'"
10 !TAB(10),"1. Add two matrices."
11 !TAB(10),"2. Multiply two matrices."
12 !TAB(10),"3. Invert a matrix."
13 !TAB(10),"4. Transpose a matrix."
14 !TAB(10),"5. Exit from the program."
15 !\!"Which operation? (Type corresponding number)"
16 Z9=INP(1)-48\IF Z9<1 OR Z9>5 THEN 15
17 !R$,\ON Z9 GOTO 18,31,56,109,124
18 REM--come here to add 2 matrices
19 !"Matrix dimensions (rows, columns), please: ",
20 M=INP(2)-48\IF M<1 OR M>9 THEN GOSUB 125\!\GOTO 19
21 !",",
22 K=INP(2)-48\!\IF K<1 OR K>9 THEN GOSUB 125\!\GOTO 19
23 X=M\Y=K
24 D=M\E=K
25 GOSUB 145\REM--data entry subroutine
26 GOSUB 148\REM--data entry subroutine
27 !"Sum of A(M,K) + B(M,K) = C(M,K):"
28 FOR I=1 TO M\FOR J=1 TO K\C(I,J)=A(I,J)+B(I,J)\NEXT\NEXT\!
29 GOSUB 143
30 GOTO 121
31 REM--come here to multiply 2 matrices
32 !"Here we multiply one matrix, A(M,K), by another one,"
33 !"B(K,N), giving a product matrix, C(M,N)."\!
34 !"Dimensions of matrix A(M,K): ",
35 M=INP(2)-48\IF M<1 OR M>9 THEN GOSUB 125\!\GOTO 34
36 !",",
37 K=INP(2)-48\!\IF K<1 OR K>9 THEN GOSUB 125\!\GOTO 34
38 !\!"Dimensions of matrix B(K,N): ",
39 P=INP(2)-48\IF P<1 OR P>9 THEN GOSUB 125\!\GOTO 34
40 !",",
41 N=INP(2)-48\!\IF N<1 OR N>9 THEN GOSUB 125\!\GOTO 34
42 IF P=K THEN 43 ELSE !\GOSUB 125\!\GOTO 32
43 X=M\Y=K
44 GOSUB 145\REM--data entry subroutine
45 X=K\Y=N
46 D=K\E=N
47 GOSUB 148
48 !"Product of A(M,K) x B(K,N) = C(M,N):"
49 FOR I=1 TO M\FOR J=1 TO N\O=0
50  FOR H=1 TO K\O=O+A(I,H)*B(H,J)\NEXT
51  C(I,J)=O
52 NEXT\NEXT
53 X=M\Y=N
54 GOSUB 143
55 GOTO 121
56 REM--come here to invert a matrix
57 !"Enter the degree of the matrix to be inverted: ",
58 N=INP(2)-48\!
59 IF N<1 OR N>9 THEN GOSUB 125\GOTO 57
60 !\!"Enter the matrix for inversion, element by element:"
61 X=N\Y=N
62 GOSUB 127
63 FOR I=1 TO N\FOR J=1 TO N
64   A(I,J)=C(I,J)
65 NEXT\NEXT
66 D=1\REM: start matrix inversion
67 FOR K=1 TO N\M=0
68  FOR I=K TO N\FOR J=K TO N
69   IF ABS(M)>ABS(A(I,J)) THEN 71
70   M=A(I,J)\I1(K)=I\J1(K)=J
71  NEXT\NEXT
72  IF M<>0 THEN 74 \ REM: M=largest element
73  D=0\GOTO 104 \ REM: Determinant=0; no inverse; quit
74  I=I1(K)
75  IF K>I THEN 68 ELSE IF K=I THEN 77
76  FOR J=1 TO N\X=A(K,J)\A(K,J)=A(I,J)\A(I,J)=-X\NEXT
77  J=J1(K)
78  IF K>J THEN 68 ELSE IF K=J THEN 80
79  FOR I=1 TO N\X=A(I,K)\A(I,K)=A(I,J)\A(I,J)=-X\NEXT
80  FOR I=1 TO N \ REM: Build inverse
81   IF K=I THEN 83
82   A(I,K)=-A(I,K)/M
83  NEXT
84  FOR I=1 TO N\FOR J=1 TO N
85   IF I=K THEN 88
86   IF J=K THEN 88
87   A(I,J)=A(I,J)+A(I,K)*A(K,J)
88  NEXT\NEXT
89  FOR J=1 TO N
90   IF J=K THEN 92
91   A(K,J)=A(K,J)/M
92  NEXT
93  A(K,K)=1/M
94  D=D * M \ REM: Determinant
95 NEXT
96 FOR L=1 TO N \ REM: Unscramble inverse
97  K=N-L+1\J=I1(K)\IF K=>J THEN 99
98  FOR I=1 TO N\X=A(I,K)\A(I,K)=-A(I,J)\A(I,J)=X\NEXT
99  I=J1(K)
100  IF K=>I THEN 102
```

```
101  FOR J=1 TO N\X=A(K,J)\A(K,J)=-A(I,J)\A(I,J)=X\NEXT
102 NEXT L
103 IF D<>0 THEN 105
104 !"Determinant is 0. No inverse possible."\GOTO 121
105 !"Inverted matrix:"
106 REM: End matrix inversion routine
107 FOR I=1 TO N\FOR J=1 TO N\!%10F3,A(I,J)," ",\NEXT\!\NEXT\!
108 GOTO 121
109 REM--come here to transpose a matrix
110 !"Dimensions of the matrix to be transposed: ",
111 M=INP(2)-48\IF M<1 OR M>9 THEN GOSUB 125\!\GOTO 110
112 !",",
113 K=INP(2)-48\!\IF K<1 OR K>9 THEN GOSUB 125\!\GOTO 110
114 X=M\Y=K
115 GOSUB 146
116 FOR I=1 TO M\FOR J=1 TO K\C(J,I)=A(I,J)\NEXT\NEXT\!
117 !"Transpose of matrix A(M,K) = matrix C(K,M):"
118 X=K\Y=M
119 GOSUB 143
120 REM--go around again
121 !"Hit <SPACE> to go on."
122 Z9=INP(1)-31\IF Z9<1 OR Z9>1 THEN 121
123 IF Z9=1 THEN !R$,\GOTO 8
124 GOTO 151
125 !"* * * * * * * * * * *"\!"*  DIMENSION ERROR  *"
126 !"* * * * * * * * * * *"\RETURN
127 !\!TAB(5),"Type",Y," item",\IF Y=1 THEN 129
128 !"s",
129 !" in each row."
130 FOR I=1 TO X
131  !"Enter row",I,": ",
132  ON Y GOTO 133,134,135,136,137,138,139,140,141
133  INPUT"",C(I,1)\GOTO 142
134  INPUT"",C(I,1),C(I,2)\GOTO 142
135  INPUT"",C(I,1),C(I,2),C(I,3)\GOTO 142
136  INPUT"",C(I,1),C(I,2),C(I,3),C(I,4)\GOTO 142
137  INPUT"",C(I,1),C(I,2),C(I,3),C(I,4),C(I,5)\GOTO 142
138INPUT"",C(I,1),C(I,2),C(I,3),C(I,4),C(I,5),C(I,6)\GOTO 142
139INPUTC(I,1),C(I,2),C(I,3),C(I,4),C(I,5),C(I,6),C(I,7)\GOTO142
140INPUTC(I,1),C(I,2),C(I,3),C(I,4),C(I,5),C(I,6),C(I,7),
       C(I,8)\GOTO 142
141INPUTC(I,1),C(I,2),C(I,3),C(I,4),C(I,5),C(I,6),C(I,7),
       C(I,8),C(I,9)\GOTO142
142 NEXT\!
143 FOR I=1 TO X\FOR J=1 TO Y\!%8F3,C(I,J)," ",\NEXT\!\NEXT\!
144 RETURN
145 !TAB(20),"First matrix:"
146 GOSUB 127
147 FOR I=1 TO M\FOR J=1 TO K\A(I,J)=C(I,J)\NEXT\NEXT\RETURN
148 !TAB(20),"Second matrix:"
149 GOSUB 127
150 FOR I=1 TO D\FOR J=1 TO E\B(I,J)=C(I,J)\NEXT\NEXT\RETURN
151 !\!"End of MATDEMO."\!\!"Back to BASIC...."
>
>
```

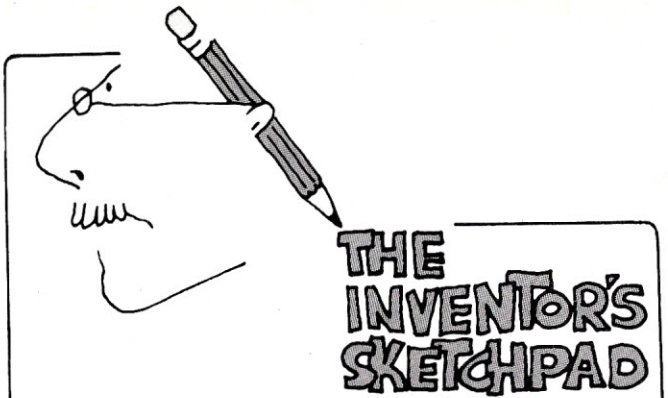
LISTING 3

```
>>RUN

       THIS IS A TUTORIAL PROGRAM ON MATRIX MATHEMATICS.

It will handle matrices up to 9x9 for most cases.

Please type the number of the operation in which you
are interested, as displayed on this `menu.'
          1. Add two matrices.
          2. Multiply two matrices.
          3. Invert a matrix.
          4. Transpose a matrix.
          5. Exit from the program.

Which operation? (Type corresponding number)
Matrix dimensions (rows, columns), please: 2,3
                    First matrix:

     Type 3 items in each row.
Enter row 1: 1,-2,3
Enter row 2: -4,5,6

   1.000   -2.000    3.000
  -4.000    5.000    6.000

                    Second matrix:

     Type 3 items in each row.
Enter row 1: 7,8,-9
Enter row 2: 10,-11,12

   7.000    8.000   -9.000
  10.000  -11.000   12.000

Sum of A(M,K) + B(M,K) = C(M,K):

   8.000    6.000   -6.000
   6.000   -6.000   18.000

Hit <SPACE> to go on.
Please type the number of the operation in which you
are interested, as displayed on this `menu.'
          1. Add two matrices.
          2. Multiply two matrices.
          3. Invert a matrix.
          4. Transpose a matrix.
          5. Exit from the program.
```

```
Which operation? (Type corresponding number)
Here we multiply one matrix, A(M,K), by another one,
B(K,N), giving a product matrix, C(M,N).

Dimensions of matrix A(M,K): 2,3

Dimensions of matrix B(K,N): 3,2
                         First matrix:

      Type 3 items in each row.
Enter row 1: 1,2,-3
Enter row 2: 4,-5,6

    1.000     2.000    -3.000
    4.000    -5.000     6.000
                         Second matrix:

      Type 2 items in each row.
Enter row 1: 9,-8
Enter row 2: 4,6
Enter row 3: -7,2

    9.000    -8.000
    4.000     6.000
   -7.000     2.000

Product of A(M,K) x B(K,N) = C(M,N):
   38.000    -2.000
  -26.000   -50.000

Hit <SPACE> to go on.
Please type the number of the operation in which you
are interested, as displayed on this `menu.´
            1. Add two matrices.
            2. Multiply two matrices.
            3. Invert a matrix.
            4. Transpose a matrix.
            5. Exit from the program.

Which operation? (Type corresponding number)
Dimensions of the matrix to be transposed: 3,3

      Type 3 items in each row.
Enter row 1: 1,2,-3
Enter row 2: 4,-5,6
Enter row 3: 7,-8,9

    1.000     2.000    -3.000
    4.000    -5.000     6.000
    7.000    -8.000     9.000


Transpose of matrix A(M,K) = matrix C(K,M):
    1.000     4.000     7.000
    2.000    -5.000    -8.000
   -3.000     6.000     9.000

Hit <SPACE> to go on.
Please type the number of the operation in which you
are interested, as displayed on this `menu.´
            1. Add two matrices.
            2. Multiply two matrices.
            3. Invert a matrix.
            4. Transpose a matrix.
            5. Exit from the program.

Which operation? (Type corresponding number)

Which operation? (Type corresponding number)

End of MATDEMO.

Back to BASIC....
>
```

LISTING 4

```
>>LIST           Program N!
1 REM: Freely adapted from "Problems for Computer Solution"
2 REM: by Stephen J. Rogowski, published 1975 by Educomp
3 REM: Corp., Hartford, Conn., page 160.
4 REM
5 !CHR$(12),
6 !"THIS PROGRAM COMPUTES THE EXACT DIGITS OF A FACTORIAL"\!
7 !"The product of all numbers from `n´ to 1, inclusive, is"
8 !"called `factorial n´ and is denoted by the symbol `n!´."
9 !"For example, 5! means 5 x 4 x 3 x 2 x 1, or 120."
10 !"An illustration of the use of factorials is the fact that"
11 !"the number of permutations (arrangements in a definite"
12 !"order) of n things taken all at a time is n!"
13 DIM S(1000)
14 !\INPUT"Enter a number: ",N
15 S(1)=1
16 M=1
17 K=0
18 C=1000
19 FOR X=1 TO N\GOSUB 24\NEXT
20 !
21 !"    "
22 FOR Z=1 TO M\GOSUB 38\NEXT
23 !\GOTO 14
24 FOR I=1 TO M\GOSUB 27\NEXT
25 FOR I=1 TO M\GOSUB 31\NEXT
26 RETURN
27 S(I)=S(I)*X
28 IF I+1-M<=0 THEN 30
29 I=M+1
30 RETURN
31 IF S(I)-C<0 THEN 37
32 Z=INT(S(I)/C)
33 S(I)=S(I)-C*Z
34 S(I+1)=S(I+1)+Z
35 IF I-M<0 THEN 37
36 M=I+1
37 RETURN
38 I=M+1-Z
39 L=2
40 IF (7*INT(Z/7-Z))<0 THEN 42
41 L=1
42 FOR J=1 TO 3\GOSUB 47\NEXT
43 IF I<2 THEN 46
44 K=K+1\IF K>8 THEN !","\K=0\GOTO 46
45 !",",
46 RETURN
47 X=INT(S(I)/10^(3-J))
48 !X,
49 S(I)=S(I)-10^(3-J)*X
50 RETURN
>>RUN

THIS PROGRAM COMPUTES THE EXACT DIGITS OF A FACTORIAL

The product of all numbers from `n´ to 1, inclusive, is
called `factorial n´ and is denoted by the symbol `n!´.
For example, 5! means 5 x 4 x 3 x 2 x 1, or 120.
An illustration of the use of factorials is the fact that
the number of permutations (arrangements in a definite
order) of n things taken all at a time is n!

Enter a number: 50


 0 3 0, 4 1 4, 0 9 3, 2 0 1, 7 1 3, 3 7 8, 0 4 3, 6 1 2, 6 0 8,
 1 6 6, 0 6 4, 7 6 8, 8 4 4, 3 7 7, 6 4 1, 5 6 8, 9 6 0, 5 1 2,
 0 0 0, 0 0 0, 0 0 0, 0 0 0

Enter a number:
```



By Roger Garrett
Contributing Editor

A SIMULATION SYSTEM

Somebody wrote a book not too long ago titled *The Complete Starship: A Simulation Project* (it is also known simply as *The Starship Simulation*). In this book the author describes the software necessary to simulate all of the functions of a spacecraft. He did not discuss, however, any of the interesting ways in which relatively simple hardware might be employed to enrich the simulation. What I am going to describe here is one such piece of hardware. However, please keep in mind that, just as the book's concepts are applicable to a wide range of simulation systems, not just the hobbyist oriented starship types, so is this hardware.

One of the major shortcomings of many computer games and simulations is the relatively low quality of its graphics. While some of the common personal computers such as the PET, Apple, and so on provide some rudimentary graphics capabilities, their respective microprocessors are hard put to provide anything tantamount to real-time dynamic displays. Displaying simple graphic symbols that move about on the display to represent targets in the classic kill-the-Klingons game is just about the best they can do. Displaying anything that actually looks like a Klingon craft and is capable of providing several perspective views is well beyond even the best personal computer.

The solution I suggest here will require some additional hardware which perhaps only the sincere simulation enthusiast will consider purchasing, but, when finally assembled and put into working order, provides him with a very sophisticated system. He will truly be the envy of his fellow hobbyists. Enough of that, let's get to the description.

Figure 1 shows the basic setup. It employs two simple turntables which can be purchased from Edmund Scientific at a reasonable price

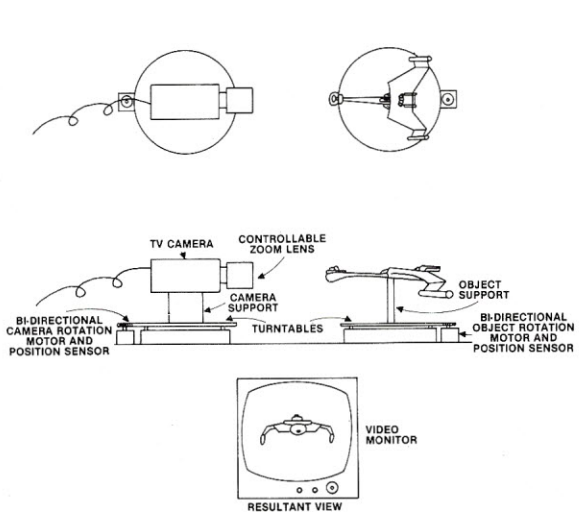


Figure 1.

(about $3 I believe). Each turntable is controlled by a simple reversible motor (also available from Edmund) and a continuous-rotation variable resistor. The motor is controlled by the computer which is running the simulation. The variable resistor, via a simple analog-to-digital convertor, tells the computer the current rotation of the turntable. This forms the position sensors mentioned in the figure.

On one of the turntables we mount a scale model of our "target." I have shown a Klingon vessel here simply because I happened to have such a model at home; of course, your target for your particular applications may be anything from globes to Apollo spacecraft to what-have-you. The support which holds the target as well as the turntable and controlling motor are all painted a flat non-reflective black.

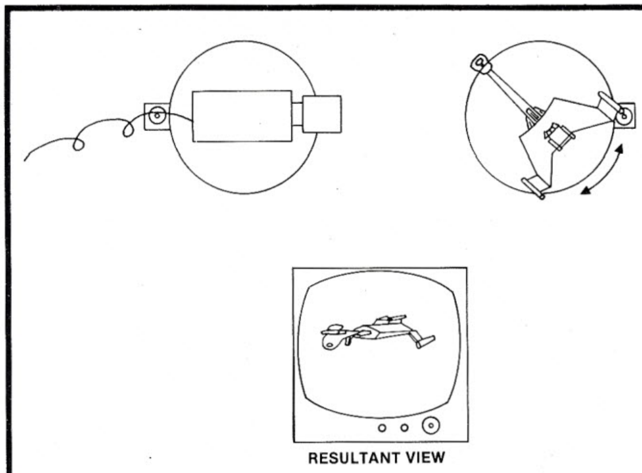


Figure 2.

On the other turntable we mount a television camera, the only major expense in this project. In my trial setup I used a camera which I built from a kit which is available from ATV Research, 13-K Broadway, Dakota City, NE 68731. It cost about $200 and unless you have considerable experience with electronics it is a very difficult kit to assemble. They also have assembled TV cameras, however, so you might see if one of those fits into your budget.

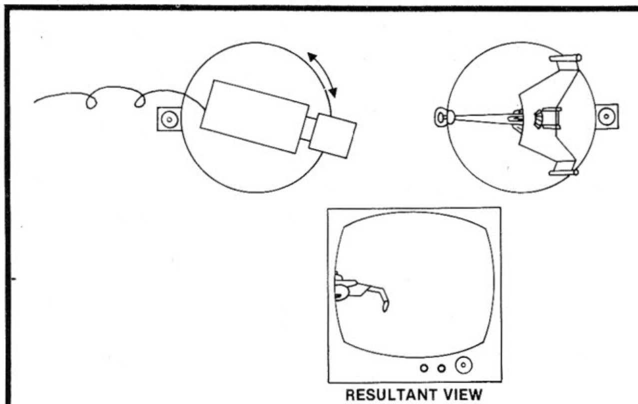


Figure 3.

On the front of the TV camera is mounted a zoom lens which can be controlled by the computer. This can be built from a spare movie-camera zoom lens and a reversible motor. Of course, if you have unlimited funds you may be able to purchase one ready made.

Finally, there is a TV monitor which displays the video image from the TV camera. The whole purpose of this setup is to provide a computer-controlled method of displaying high quality images of simulation models.

In Figure 2 we see what happens when the computer causes the model turntable to rotate. In Figure 3 the camera turntable has been rotated, which causes the resultant model view to move left or right on the monitor. The final control is shown in Figure 4 in which the zoom lens setting has been changed by the computer so that the Klingon vessel appears far away.

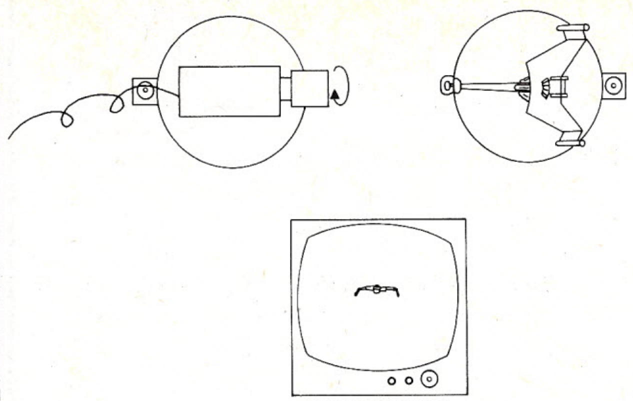


Figure 4.

Now imagine that we have a sophisticated Star Trek program running. Instead of the simple display of quadrants with simple symbols indicating the enemy vessels, we actually "fly" the Enterprise through space. When the computer determines that the Klingon is within visual range it turns the camera turntable position, the zoom lens setting, and the model rotation so that we see on our monitor a real-time image of the vessel. As we move towards the Klingon the computer controls our simulation hardware appropriately so that it appears bigger on the screen. As the Klingon tries to outmaneuver our starship, its movements are reflected in what we see on the screen. The result is that we actually feel like we are flying through space while looking out our forward viewport.

As mentioned earlier, we needn't limit ourselves to starship simulations involving Klingons. We might, for example, write an Earth-orbiting simulation in which we take off from the surface of the Earth and attempt to establish orbit, assuming that "we" are inside

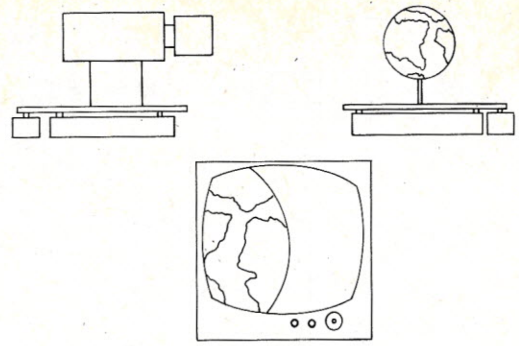


Figure 5.

the space shuttle. To do this we could substitute a globe for the Klingon vessel, as in Figure 5.

And finally, we can extend this system by incorporating several model turntables in individual cubicles surrounding a single camera turntable as in Figure 6. With this setup we might lift off from Earth, establish orbit around the moon, and rendezvous with Skylab or the Space Shuttle, all under computer control which provides us with realistic views of the objects as we fly up to them, attempt to dock, establish orbit, or even destroy.

All of this sounds like quite an undertaking, and it is. The camera and controllable zoom lens will be the hardest parts. The turntables and motors and their controlling circuitry should be relatively straightforward, however. The software will have to be written in machine language and will prove to be an interesting challenge. But once it is operational it can provide endless hours of fascinating simulation.

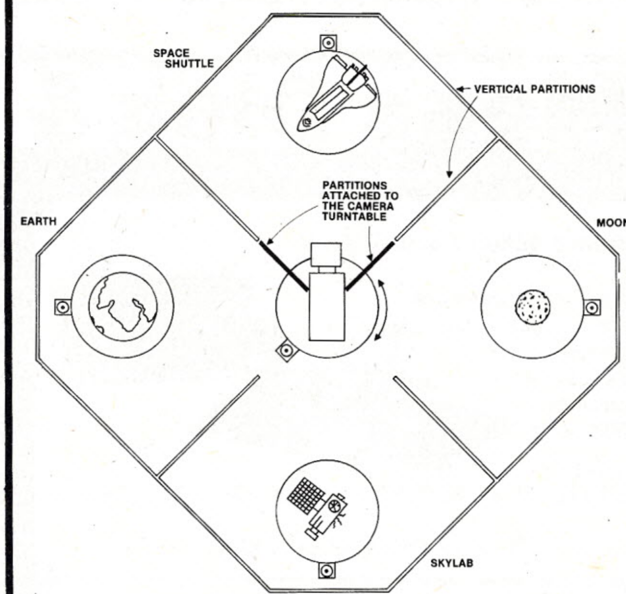
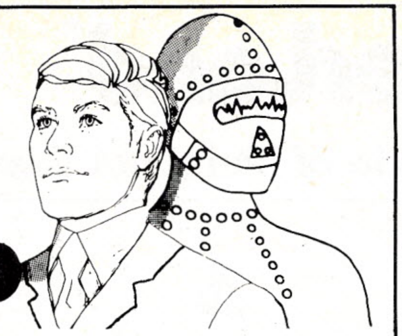


Figure 6.

I suggest that anyone considering building this hardware get together with some friends to share the work and the fun. This should be an ideal project for a computer club since it entails all levels of hardware and software expertise. It can be a challenge for the expert as well as the novice.

If you or your group decide to attempt this project please drop me a line and let me know about it so that we may share ideas about particular applications, modifications, and enhancements. You may write to me at The Inventor's Sketchpad, 16 Grinnell Street, Jamestown, RI 02835.☐



THE MIND REVOLUTION

By Merl Miller

Last month I left you with a challenge — can you devise a system that will handle spelling errors? In the chart introduced in the July issue, the fifth, sixth and seventh naive user responses (*dlete, quite* and *Chagne*) all represent spelling errors. Four-fifths of all spelling errors (in English text) are due to one of these four problems:

1. one letter is wrong
2. one letter is missing
3. one extra letter has been inserted
4. two adjacent letters have been transposed

Now, if you will accept a rude response from the computer 20% of the time, we can solve this problem. Our menu scheme might be this:

1. See if the words in the user response match dictionary words perfectly. If there is an unambiguous result, return.
2. See if words in the user response match dictionary words, taking possible spelling errors into account. If there is an unambiguous result, return. Otherwise, give an error message and ask the user to try again.

Figure 1 shows an algorithm for sensing possible spelling errors. It takes a single word from the user response and a single word from the dictionary. If the two input words are the same, or slight permutations of each (i.e., they fall into one of the four common categories), the routing returns TRUE.

If we tack all the previous ideas together with this one, we have a menu routine that can handle abbreviations, single words, phrases and other multi-word inputs, including most misspellings. Our routine can handle user responses from *a* through Quit and *I really want to chagne one record. Will you do it?.*

With the eighth naive user response in the original chart, *I don't want this record here any more.*, we've probably passed the realm of current-day microcomputer practicality. In this instance, the meaning is conveyed by patterns of words and our menu routine would have to deal with the interaction of individual word meanings with grammatical forms instead of looking for meaningful words in isolation. At the very least, the dictionary would have to include hundreds of words, plus something about the grammatical form of each.

The ninth user response, *I give up!*, seems even harder than the eighth, precisely because it is a special case; that is, an idiom. It seems no analysis of the syntax and meaning of the sentence would be adequate without knowing that "I give up" means "I quit". It seems the only way to handle responses like *I give up!* or *I've had it!* or *Crash, you stupid computer!* is storing huge numbers of special cases. And, until the time when picosecond, megabyte, dollar-fifty memory arrives, this response is beyond our reach. About the only thing we can do is try to make the user feel better. This is best handled by counting the number of times the computer is forced to display: I DON'T UNDERSTAND.

If this message appears three times in a row, this message could be displayed: THERE, THERE, IT'S ALL RIGHT. WON'T YOU TRY AGAIN?

What have we done here? We've started with a common problem and outlined a number of solutions. We've biased our solutions to the long-range direction of "more intelligent." We've come up against some boundaries, but we have seen some ways to make practical menu selection routines more polite, if not terribly more

```
spelling_error(response_word, dictionary_word)
  if length(response_word)>length(dictionary_word)
                              then
                                s —dictionary_word
                                l —response_word
                              else
                                s —response_word
                                l —dictionary_word
  if length(l) - length(s)>l  then
                                error_count —2
                              else
                                error_count —0
  while error_count<2 and length(s)>0
    while leftmost(s)=leftmost(l)   and length(s)>0
                       remove first character of s
                       remove first character of l
    if length(s)>0
        then
          error_count —error_count+1
          transposition —FALSE
          if length(s)≥2 then
                    if leftmost(s)=second
                    character of 1 and
                    second character of
                    s-=leftmost(l)
                   then
                     remove first two of s
                     remove first two of l
                     transposition —TRUE
          if not transposition then
                  if length(l)>length(s)
                  then
                    remove first character of 1
                  else
                    remove first character of s
                    remove first character of l
  if error_count<2 then spelling_error —TRUE
                   else spelling_error —FALSE
  RETURN
```

The routine spelling_error returns the value TRUE if response_word could be a misspelling of dictionary_word. If there's not a chance (according to the rules) that the response_word could have been meant to be a dictionary_word, the routine returns FALSE.

First, the routine puts the shorter of the two input words in s, and the longer in l. If 1 is more than one character longer than s, we give up by setting error_count to 2.

If s and l are of the same length, or differ by only one, we enter a while loop which continues until we have found two errors, or until s is depleted. On each pass through the main while loop, we first remove all matching characters from the fronts of s and l. If after doing that, anything is left of s, it must be due to some sort of disagreement between the words. If s has at least two characters in it, we test for the possibility of a transposition error. If there is such an error, we strip the first two characters off both s and l, and go around the main while loop again, looking for more errors. Otherwise, spelling mistake 1, 2, or 3 must have occurred, so we throw away the character(s) causing the mismatch, then go around the main while loop again.

Figure 1. A spelling correction algorithm.

intelligent. More importantly, though, we've laid out a method of problem solving that looks at a problem and attempts to derive a solution in terms of the end user.

If you missed the first two installments of this series, look back in the July and August/September issues. If you ever tried this method of problem solving or programming, we'd like to hear from you. If you would like to delve into this a little more, watch for Rich Didday's new book, *Principles of Polite Programming.* You may also want to read, *Spelling Correction in Systems Programming,* by Howard L. Morgan, pp. 90-94 in Vol. 13, No. 2, February 1970 issue of *Communications of the ACM* or Robert Schonk and Kenneth Colby's book, *Computer Models of Thought and Language,* W.H. Freeman and Co., 1973.☐

If you have any opinions, ideas or suggestions relating to the theme of this column, contact Merl Miller at 30 N.W. 23rd Place, Portland, OR 97210.

BUSINESS SOFTWARE REVIEW

By Carl Heintz

In this month's issue we will focus on word processor software packages, with the following products being investigated:

- LETTERIGHT, by Structured Systems Group
- WORDMASTER, by Micropro International
- TEX-WRITER, also by Micropro International

LETTERIGHT

The Structured Systems Group people have rightfully earned the reputation for producing professional programs which are documented and easily implemented. LETTERIGHT is no exception. Designed to run under CP/M with CBASIC, the program needs 48K of RAM memory, at least one floppy with minimum capacity of 70K, a printer capable of skipping to the top of the next form (in response to ASCII form-feed), and a CRT with a minimum of 24 lines by 80 characters.

The program is designed to be implemented by those who are barely literate in programming. The SSG documentation was designed to lead the user carefully into the LETTERIGHT system with a minimum of unanswered questions.

The programs are provided on a 5¼" diskette, configured for a Hazeltine 1500 terminal. Simple instructions are given to change terminal configuration to an ADM 3A, Beehive, Cromemco, Dynabyte, Soroc IQ120, or Imsai VIOC. Other terminals can be used. However, a program will have to be run to generate the correct parameter file (a simple task).

The bells and whistles included in the program include an automatic reminder that the typist is near the end of a line, automatic line feed, and automatic line numbering. Additionally, pagination is easily included. There is one minor problem which can arise for a first time user with a large document. The program, of course, has a maximum document size, which is expressed in lines. For a 48K system, this limit is 250 lines of text. Larger documents can be handled if the document is broken up into various separate files. For a 64K system, the maximum size is 750 lines.

The user is responsible for keeping track of the document size. Should the operator be careless in this regard, the manual is explicit in what the program will do: "if none of the document has been saved, you will lose all of it." This limitation is not serious, and fortunately, the SSG programmers have documented it well.

Basic Functions

The SSG LETTERIGHT program offers a number of functions which differentiate it from a DOS line editor. This distinction is important, since most operating systems include line editors which can be used as primitive text processors. The SSG system, obviously, goes much further, including some of these functions:

a. Insertion of a block of characters
b. Flexible addressing of the text through easy manipulation of the "cursor"
c. Controllable scrolling of the text by a specified number of lines
d. Movement of lines of text within the document
e. Reading a file into the text
f. Modifying the text line through various operators
g. Tab function
h. Pagination
i. Use of substitution texts

Of the functions mentioned above, one of the most useful is the ability to read a file into the text. This allows, for example, the addressing of form letters individually. A "name and address" file can be constructed and then "individual" letters sent to each.

It is difficult to criticize the SSG LETTERIGHT programs. They are well written and documented, using them is simple, and, of course, they perform their intended tasks. However, the buyer should be aware that the programs do not perform any of the following tasks:

a. They are not designed to format output (such as in right-justification, etc.)
b. They are not designed to create special characters (such as "banners" or enhanced characters (useful for text headers, for example)
c. They are not designed to work in an environment in which the line length is longer than 70 characters.

However, within the framework of what the programs are supposed to do, they do an excellent job. SSG believes in the system: they produced their entire manual, except for the headings, using it.

WORDMASTER

An alternative program to the LETTERIGHT program is the WORDMASTER program produced by Micropro International. This program is also designed to function under CP/M. The introductory materials which accompany the program define it as essentially a replacement for ED, the CP/M line editor. However, the program is far more than that, with numerous enhancements and powerful features.

The WORDMASTER program requires at least 20K of memory, an 8080, 8085 or Z-80 microprocessor, and floppy disks running under CP/M. The video edit portion of the programs can be interfaced with a number of terminals, including ADM-3A, Soroc, Beehive, Hazeltine 1500, and Imsai VIO. Others can be handled, assuming that the operator does some "patching" (detailed instructions are included).

The WORDMASTER manual is separated into two distinct sections — the "introduction" and the "operator's manual." These two sections contain a somewhat technical description of the programs and an "introduction" which was obviously written for the uninitiated. When we received the evaluation copy and began reading the introduction, our first impression was that this program would be far too complex for the average secretary to ever comprehend, since it was written at about the same technical level as the CP/M documentation. While the WORDMASTER introduction is not that complex, it nonetheless requires careful study to fully comprehend. However, I found that part of the power of the programs lies in the excellent documentation of its components and how the commands can be used.

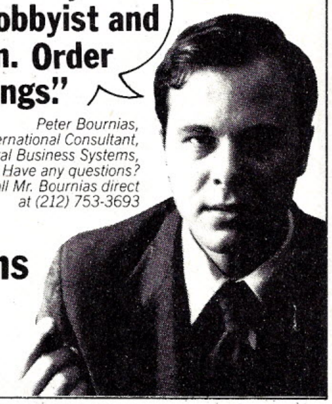
The place to begin with WORDMASTER is with the operator's guide. This 26-page manual was written for the novice in mind. The guide is in fully conversational English, with few ambiguities. Where there are important points, the manual contains exercises for the novice operator. These are logical and easy to perform, with a vast amount of educational benefit.

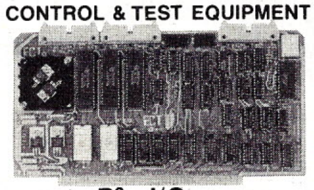
WORDMASTER has three "modes" of operation, which are:

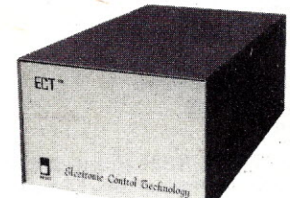
a. Video mode — in which a portion of the file is displayed on the CRT and the display is continually updated as changes are made in the file.
b. Command mode — in which the entire text is edited. It's used for searches, global replacements, text moves, etc.
c. Insert mode — in which text typed in is inserted into the file

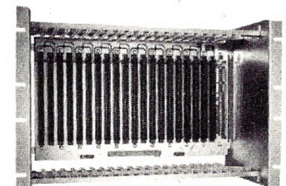
The operator will appreciate the numerous tab and cursor movement commands only after a little practice. But with Word Tab (skipping to each word), 4-way cursor movement, screen tab, line tab, and so forth, it is easy to become confused at first. However, the power and flexibility provided are well worth the initial effort.

Micropro devotes in excess of 24 pages describing the commands in the manual, in addition to the 24-page operator's manual which is essentially entirely devoted to commands. There are over 60 commands which can be implemented. While not all of these are necessary to use WORDMASTER effectively, they bespeak of the immense power available to the knowledgeable user. I spent several days using WORDMASTER and at each session I discovered a new aspect to the system.









What It Lacks

There are a few things which WORDMASTER does not address itself to. The most important of these is the ability to interface with name and address files for the production of form letters. These functions are covered in a companion program entitled TEX-WRITER which will be reviewed elsewhere in this article.

WORDMASTER should be viewed as its authors intended — as a text editor, and not a complete wordprocessing system, as the SSG LETTERIGHT system is. There are advantages to this separation, and Micropro obviously had reasons for limiting the content of WORDMASTER.

TEX-WRITER

TEX-WRITER is a text formatting program which is designed to be used with a text editing program to create form letters. Files can be linked and printed together and so forth. TEX-WRITER operates by reading a file from a disk, formatting the file and then printing the formatted text onto the printer. Of course, the files must first be created by a text editor.

One could use the CP/M ED editor, WORDMASTER, or even use LETTERIGHT. To use the TEX-WRITER program, an 8080, 8085 or Z-80 CPU is needed, with at least 24K of memory and at least one drive operating under CP/M.

There are some enhancements which set the TEX-WRITER package apart from other programs. One is the ability to handle up to 132 column output, and justify it right or left. Another is the ability to interact with the operator on multi-page output, to request a new piece of paper for the printer, for example.

The program has over 30 commands, allowing a wide flexibility in the output, and the control which the operator has over that output. Some of the more important and unique control functions which TEX-WRITER has are:

a. The ability to center text between right and left margins, in addition to the justification routines
b. The ability to number chapters
c. Define a heading or a footing (at the bottom of the page) which will appear on every page (up to 30 characters can be specified)
d. Set margins to whatever is specified
e. Paginate and number pages
f. Pause at the top of each new page and wait until the operator has paper loaded or indicates "continue"
g. Set margins, set spacing (between lines), set tabs and, under program control, alter tabs (for example, one could have two sets of tabs in a document)
h. Ignore comment lines (in other words, it is impossible to have non-printing comment lines in the text material)
i. Allow for the splitting of words on given character types (such as "-"). Note that the program normally will not split words — the spacing is changed in the line instead.

The TEX-WRITER manual is simple and easy to comprehend. It is written in a more elementary manner than the manual for the WORDMASTER program, probably as a result of the level of the program. TEX-WRITER is easy to implement and use.

CONCLUSIONS

The programs reviewed here represent only three of the many word processing related packages which are currently available. All three of the programs are excellent in their technical construction, and documented fairly well for even the novice user. The choice between a LETTERIGHT or WORDMASTER program depends, in the end, upon the desires of the user. If a simple, effective program is desired, with limited expansion capabilities, then the SSG program is indicated. If on the other hand, the user is more technically oriented and expects to be able to employ the full power of a program such as WORDMASTER, along with the companion TEX-WRITER, then the Micropro programs are indicated.

Novices to the world of computers or word processing would probably find initially that the SSG programs will be up and running easier. However, for old pros and those looking for something upon which to build complex systems, Micropro will serve well. □

Carl Heintz and Bob Johnson will be alternating as authors of this column. Software vendors who are interested in having their product reviewed can contact Carl Heintz at 2540 Huntington Dr., San Marino, CA 91108. Bob Johnson can be contacted at 7228 W. Reno St., Rt. 5, Oklahoma City, OK 73108.

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THE COMPUCOLOR DREAM MACHINE

By Carl Warren, Editor-in-Chief

Computers have always been associated, at least to a degree, with science fiction — fantasy, the unbelievable dream. Science fiction writers have made the computer into everything from tyrants to almost lovable companions. Just about everyone who watches television is familiar with the Enterprise's magnificent computer that embodied all of human knowledge.

Today, real life computers are making some of the science fiction dreams come true. Computers help you bank or buy an airline ticket. You can even bring a computer home to simplify daily chores or to provide another level of entertainment.

CAPITALIZING ON A DREAM

Because the concept of fantasies is so important in selling a machine like a computer, successful manufacturers have capitalized on this idea to capture the prospective buyer's imagination.

Compucolor Corporation, a leading manufacturer of high-technology computer systems, has been able to combine fantasy and reality in their line of personal computers.

The secret behind the Compucolor is its distinctive packaging and clarity of color graphics. The 9 x 6¾ inch screen is housed in an attractive wood-grain finished cabinet. The cabinet also contains the necessary memory modules, and the electronics that allow communication to the outside world and the central processing unit, an 8080A.

The keyboard that the Compucolor systems use is designed to allow the user to have full control of all screen functions; such as moving the cursor and color control.

The general design concept behind the Compucolor series is to enhance the customer's imagination. Combining the keyboard functions and screen graphics, the machine performs extremely well.

THE COMPUCOLOR SERIES

With the user utmost in the minds of Compucolor designers, several models of the machine are offered. Like any computer system, each option adds more capability. However, it must be understood that the Compucolor is one of the few machines that comes complete with CRT, keyboard, disk, and ROM BASIC even for the lowest priced Model II version, at less than $1,500. The basic options offered include expanded memory up to 32K. Three choices of keyboards, each designed to ease programming tasks with the addition of function keys. An additional disk drive can also be added to expand the total disk storage to 100,000 characters. A fully expanded system with the Deluxe keyboard, 32K of user RAM, and additional disk can be purchased for under $3,000.

WHAT YOU CAN DO WITH COMPUCOLOR

The Compucolor's built-in flexibility, particularly in the use of graphics, makes the machine the ideal tool for several useful areas. The first, and the one that is traditionally associated with small computers, is games. With the Compucolor, games become more alive and interact with the player more than is possible on non-graphic type systems.

A feature that captures most people's imaginations is the depth and clarity of the displayed graphic characters. Even children enjoy the quality of the graphics. This is accomplished on the 13-inch diagonal color screen by turning on any of 16,484 individual plot blocks. Each block can be shaded any desired color to enhance the display.

Due to the number of accessible plot blocks on the screen points can be generated as small as a pinhead. Even more unique is that individual points or entire blocks can blink. Movement on the screen is simulated by progressively turning the graphics points on and off.

The Compucolor is really an exciting machine for educational purposes, either using user-written programs or the educational packages available from Compucolor.

An application area that should excite managers and business planners is to use the machine in simulations or

graphic report generation. By using the graphics capability of the machine, bar charts, growth diagrams, even architectural designs can be displayed and updated at the user's whim.

The possibility of using the Compucolor as a file keeping system in a doctor's office also exists. Imagine displaying a patient's chart, showing a graphic representation of the area of concern, with all the updated information in written and graphic form. This possibility brings other similar applications to mind for the enterprising software creator.

PROGRAMMING THE COMPUCOLOR

The Compucolor system is easy to learn to program primarily due to the ease of operation of the system. When the system is turned on, BASIC is activated. The version used is a special graphic disk BASIC that is designed to give the programmer ease of function and accessibility to the graphics functions and file handling capability of the operating system.

Special functions such as PLOT are used to direct information to different areas in the system, for PLOTting a chess board or a sales display graph. The information can also be directed to the printer or modem port depending upon what the application calls for.

SOFTWARE AVAILABLE

The general operating software, disk operating system and BASIC language, comes with the system on ROM (Read Only Memory). To make the system enticing and keep the dream alive, Compucolor offers a number of games and personal business diskettes. The two most popular are Chess and Othello, either of which can keep the player entranced for hours.

For those who write their own software, Compucolor provides pre-initialized diskettes for saving the programs. They are also very interested in reviewing user written programs for inclusion in the Compucolor library.

Another company developing software and add-ons for the Compucolor systems is CAP Electronics. They have created a Soundware system that adds a sound generation device to the Compucolor through the RS232 port located on the rear of the machine. The Soundware package includes the sound generation module and software to make it work. Software also helps users generate their own sound programs.

CAP also provides games designed to take full advantage of the system graphics. These games include Space: 2020, which is an exciting space trading game that involves several unusual factors. Also available is Dungeon Quest — based on the currently popular devils and dungeons game.

For war game aficionados, Lightning Command pits two armies against one another. The game requires skill and daring to win. All the CAP games sell in the $20 to $25 range.

MANUALS AND GUIDES

Compucolor has made every effort to enhance the system as far as capability goes. However, they realize that documentation is just as important as hardware and software. Therefore, three manuals are available: The short form instruction manual which gives the necessary information to immediately start using the system. The programming manual describes all the functions available to the programmer, along with numerous examples. Also available is an in-depth maintenance manual which covers all the electrical and mechanical functions of the machine.

All the manuals are written with the user in mind. An easy-going clear, concise format is followed, even in the explanations of the technical operation of the system.

Compucolor is definitely a system of the times and promises to be one of the big three personal systems of the 80's.

For those interested, additional information about any of the Compucolor systems may be obtained by writing or calling Rodney Hunt, Compucolor Corporation, P.O. Box 59, Norcross, GA 30071; (404) 449-5996. CAP Electronics is located at 1884 Shulman Avenue, San Jose, CA 95124, (408) 371-4120.□

Personal Computers in the Classroom

By J. Olin Campbell
World Institute for Computer Assisted Teaching

They are not as comely as the human versions, but new computerized teacher aids may soon be helping thousands of teachers who have had enough of grading papers into the night.

Students using early systems made significant gains when they worked on the computer, but they sometimes failed to finish the exercises because they could not benefit from a teacher's encouragement and expectations. This same problem may afflict home users of computer assisted instruction (CAI).

The microcomputer, which has catapulted into thousands of homes and businesses, is now finding its way into the classroom as an aid, not a replacement, for the teacher. Running on inexpensive microcomputers, available programs now give students practice in basic and advanced skills, grade their exercises and tests, and prepare personalized reports.

Among the manufacturers with micro systems in the personal computing range, priced between $600 and $2,500, are Apple, Commodore, Compucolor, Exidy, Radio Shack, and Sol. All have had general purpose microcomputer systems out for over a year for use in schools, homes and businesses. These firms are being joined by Atari, Hewlett-Packard, Mattel, and Texas Instruments, who have recently announced or at least developed microcomputer systems. The new entries portend an era of competition and growth in personal computing likely to parallel that of the office copier and pocket calculator.

For example, industry sources indicate that in 1978 the Radio Shack TRS-80 grossed $100 million in sales, while the Apple sold $30 million and the Commodore PET sold $20 million. These figures indicate the beginning of a huge potential market which may have ups and downs, but can be expected to grow considerably. The plummeting cost of random access memory (RAM) and the likelihood of inexpensive bulk memory (e.g., bubble memory) are likely to further accelerate market entries.

At present the microcomputer systems are often weak and fragile: promised instructional programs are often of poor quality, and inexpensive storage such as tape cassettes is notoriously unreliable. This leads to frustrated users. Mini floppy disks are better for storage but are also more expensive.

Bubble memory cartridges should be far more reliable and faster than tape cassettes, but their cost in relation to diskettes is uncertain. Less expensive bulk memories coupled with larger internal random access memories will permit programmers much more flexibility to write good programs.

DISTRIBUTED INSTRUCTIONAL SYSTEMS

Personal computers offer cost savings, but most of the professional courseware written to date assumes the large RAM and

disk storage available on a time-sharing system, as well as a shared database for programs and student histories. Without good student histories, the curriculum remains a game, with the student picking a difficulty level each time he uses the computer. With adequate histories, the student can pick up at the point where instruction left off at the last session, and the program can make decisions or offer advice based on previous performance.

Distributed instructional systems in schools will permit users to link inexpensive microcomputers to common databases for programs and student histories and to share expensive peripheral items like line printers, large disk memories, and screen printers. In addition, the distributed instructional system will permit the traditional advantages of a time sharing network in which several users can interact.

Essentially, a distributed instructional system is a selection of stand-alone microcomputers, each of which can make calls on a central facility for data, or access to a peripheral device. If the central facility goes down, the micros will continue to operate, unlike a timeshare system. Nestar Systems of Palo Alto, California has recently announced a distributed system for personal computers using the Commodore PET as a controller.

AUTHORING SYSTEMS

Professional courseware development has been very expensive. Yet personal computer buyers sometimes think that the programs will come to them free, like those on TV. Therefore the advertising to "Give your child a personal tutor" usually refers to a few inexpensive programs that do very simple drills and practices. Sometimes the programs are lacking altogether, or are awful. These programs incorporate immediate feedback but they lack the comprehensiveness and rigor one normally expects in a published piece of courseware.

In the past, the cost of hardware and of programming the software and courseware were prohibitive for everyday computer applications in the schools. Now hardware prices are falling and a number of authoring systems are being produced, dramatically decreasing the cost of preparing instructional materials by eliminating the programmer.

An authoring system is more than an authoring language. In a true authoring system, the author is guided and prompted by a set of prototypes, which are tailored to a specific application by an instructional designer. After the initial prototype has been prepared, subject matter experts can easily prepare the materials and try them out immediately. WICAT has developed an authoring system of this type which uses a number of standard and proven prototypes.

The authoring system includes a translation capability, so that courseware written in the language for one microcomputer can be rapidly translated with very slight manual intervention into a number of other languages for use on other machines. At present the competing machines and languages have fragmented the market, so that developers of new programs for a specific machine find a relatively small market for their product. The translation capability may be the means by which a sufficiently large market can be generated for a given program to attract the capital necessary for excellent instructional development and production.

COMPUTER COURSEWARE

A number of firms are already marketing nationally-distributed computer-based materials for elementary and secondary schools. The Computer Curriculum Corporation (CCC), using a drill and practice format pioneered by Richard Atkinson and Patrick Suppes at Stanford, has marketed and repeatedly demonstrated the effectiveness of hundreds of hours of instruction ranging from elementary reading and mathematics through high school GED instruction. The PLATO computer network also includes elementary reading and mathematics, as well as a wide range of other topics and courses.

Equipment manufacturers like Digital Equipment Corporation, Hewlett-Packard, and Univac also support educational users, though they are not as oriented to producing courseware. In addition, some in-state groups like Minnesota's Total Information Education System (TIES), the Minnesota Educational Computer Consortium (MECC) and the Oregon Council for Computer Education distribute computer instruction to classrooms.

Other well-known projects like the Huntington Project at the State University of New York at Stoneybrook and SOLOWORKS at the University of Pittsburgh have produced strong simulations and courseware. Some projects have taken programming as the curriculum itself, to help students discover thinking skills. Project LOGO at MIT is the prime example of this approach.

A number of courses are now being prepared and marketed for personal computer systems. For example, WICAT has completed a mathematics system which is available in both school and home versions for the Radio Shack, Commodore PET, and Apple computers. WICAT has also prepared reading, English courses and math helps (which go beyond drill and practice to instruction).

These courses must all be divided into a number of lessons which are stored on individual diskettes. The distributed instructional system, such as is being developed by Nestar, will avoid the interim solution of the floppy disk.

SPEECH PRODUCTION

A number of new developments are extending the capabilities of computers for instruction even further. The developments are now generally too large or expensive for personal computers, but distributed systems and larger memories may change the picture.

For years, speech systems have been used on large computer systems for instruction. Speech (audio) is required in some applications like elementary reading, where the student cannot be expected to read the directions. Speech is also a benefit when working with older students of low reading ability or with blind students. In other applications, it is useful when used judiciously for simulating verbal interactions (e.g., the control tower calling an aircraft pilot) and for motivation.

Speech systems are very expensive because they require huge amounts of computer memory to digitally record and play back spoken words. Digital encoding is required for reliability and speed of random access. Analog magnetic tape and disk systems have been used for years, but they are notoriously slow and quickly out of adjustment when random access is required.

Recently a number of laboratories have developed a technique called linear predictive coding (LPC) which permits significant reductions in the amount of memory required to store a given amount of recorded speech. At the same time, voice synthesis from phonemes or formants has been used and is being improved. In voice synthesis, individual sounds (phonemes) are produced by the hardware rather than recorded from speech. The memory saving is prodigious, since the only information to be stored is how to string together and vary the intensity and pitch of these phonemes to make words and sentences with the proper inflection.

The problem of inflection (prosody) is far from solved. We cannot yet put together phonemes to reliably produce clearly understood individual words, because our human perception of the same sound depends upon the context in which it is heard. Moreover, we do not yet understand how to string together words to produce natural sounding continuous speech rather than the stereotyped choppy "computer voice."

At present LPC is the highest fidelity technique for speech using relatively little memory. Using it, phrases and sentences are far better when recorded as wholes than when formed by stringing together individual words. It can be expected that the techniques for speech production will continue to evolve toward higher fidelity, more natural sounding continuous speech, and smaller memory requirements.

A number of home products with speech production are already available. Perhaps the best known is Texas Instruments' Speak and Spell. Speech production add-on components to personal computers are being marketed by several firms, including Mountain Hardware in Santa Cruz, California; Computalker in Santa Monica, California; Votrax Divi-

sion of Federal Screw Works in Troy, Michigan; and Speech Technology of Santa Monica, California.

GRAPHICS

Graphic systems are also being developed for micros, so that simple line drawings using relatively high resolution graphics are now possible. Color is being added, so that the visual excitement of what appears on the screen will be far higher than the long strings of text associated with older forms of instruction delivered by computers.

Graphics are important in instruction for low verbal students and for topics where visualization is crucial (e.g., portraying the relative positions of the planets). The most relevant application is for dynamic displays for simulation, which vary depending upon the student's input.

Graphics need not be complex to be instructionally powerful. In most cases black and white line drawings can be shown to be just as instructionally effective as more involved graphics. Nevertheless, high resolution color graphics tend to catch the eye and contribute to motivation.

Because high resolution requires lots of memory to refresh the screen, designers of instruction for personal computers must trade program size for resolution. As RAM becomes inexpensive this limitation may ease.

Several centers are now investigating graphics which can be used on micros. Perhaps the best known are the Xerox Palo Alto Research Center (PARC) and Alfred Bork's physics computer development project at the University of California, Irvine. Their work using graphics for instruction now uses larger machines than the inexpensive personal computers found in many classrooms, but the work has immediate application as the power of personal computers grows.

THE VIDEODISC

Another element which may change the way microcomputers can be used is the intelligent videodisc. This system combines text, video motion, and computer-assisted instruction. The videodisc itself resembles a phonograph record, but contains television programs which can be stopped on a single frame to present a still picture or a page of text. This means that individual still frames can deliver the bulk of instructional content, while motion sequences and high resolution color graphics can also be used. Videodiscs or their equivalent are likely to become very popular in homes because they can deliver feature length movies inexpensively on a few discs.

The intelligent videodisc is a marriage of the microcomputer and the videodisc. The microcomputer contains the software and courseware, while the videodisc player displays up to 54,000 individual color pictures and text pages or up to 60 minutes of motion with color and stereo sound on a single side of one disc. WICAT has developed an intelligent videodisc system, together with the authoring and production procedures to use it. The first IVD instructional programs have just been completed.

INTELLIGENT CAI

The following items address current problems in providing capable instructional aids, but the solutions may be years away. Research on these topics typically uses large computers, but with yesterday's monster becoming today's mini, and with distributed systems, it is likely that the micros of the future can tackle these problems.

One of the most serious challenges to instructional designers writing for personal computers is to provide the program an "understanding" of the student even remotely as rich as a human aide who learns the student's habits and characteristics. It is possible to keep records of every key press the student makes; but to interpret and make inferences using this information, then to use the inferences to help the student can be quite another matter.

Computerized teacher aids are learning to identify the strengths and weaknesses of each student and to adjust practice exercises accordingly. This capability is intelligent computer-assisted instruction (ICAI). The program "knows" what the expert teacher knows about the material to be learned; it knows how the student has been performing, and it can therefore determine what instruction is needed to help the student perform more like the expert.

In this way instruction can be made responsive not only to the single answers the student gives but also to the particular student's abilities on a number of tasks over time. A number of university and industry labs are pursuing ICAI. The fallout from their work should find its way into instructional programs for the classroom in the next few years.

NATURAL LANGUAGE PROCESSING

Today the student must respond to the computer using a very limited language which the computer can understand. While the computer can print out or even speak quite complex sentences and can present graphics to the student, the student's response is usually limited to a few typed characters or a touch at a point on the screen. For a number of years researchers have been trying to give computers the capability to understand "natural language." This means that the student could use English, or any other language which the computer was programmed to recognize. This has proven to be an extraordinarily subtle and complex problem, and a true dialogue is impossible on personal computers with present limitations, though approximations have been made on larger machines.

VOICE RECOGNITION

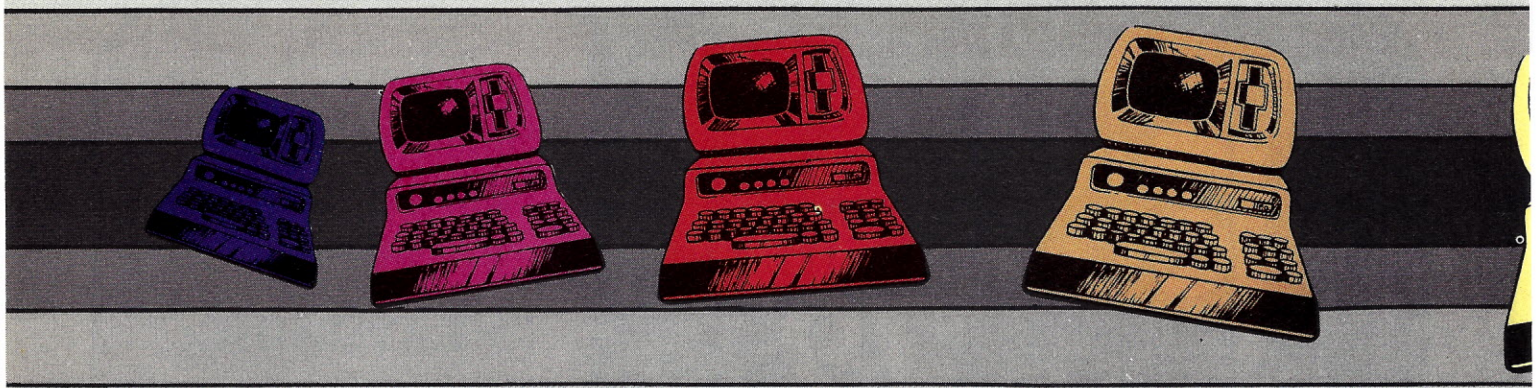
An extension of natural language processing is voice recognition, where the computer understands speech as well as written communication. Speech recognition has been accomplished for years using 10 to 50 word vocabularies. Already, Heuristics, Inc. makes a speech recognition system for personal computers. Nevertheless, the speech recognition field is far from solving the communications problem faced by instructional designers.

Usually the system can handle only one word at a time, and is tuned better for some voices than for others. Some systems learn the characteristics of each person's voice speaking each word to be recognized. In special applications these capabilities are sufficient. For conversation they are not enough. It is likely to be some time before a continuous speech recognition system can run on a personal computer.

Using speech recognition and natural language processing, it will be possible in some applications to replace the relatively complex terminals with which we are all now familiar with a simple telephone set. A student could call in and converse with the computer aid to receive personalized instruction in somewhat the same way as the student might have a conversation with the teacher after class about a topic of interest. Approximations to this situation have been demonstrated for several years, by limiting the number of words the student can speak to the computer, and requiring them to be spoken one at a time.

THE PROSPECTS FOR PERSONAL COMPUTERS IN THE CLASSROOM

Personal computers are already in hundreds if not thousands of classrooms across the country. Typically they are used for games, to learn programming, or for locally-produced instructional exercises. As has been described, a number of problems face developers of quality courses to be delivered on personal computers. It is likely that after the false start of the late 1960s, publishers will again distribute computer instructional programs. This time they can look to a much larger market (if they can translate for different machines) which can repay the heavy development costs. The opportunity is before us to multiply and replicate the work of good teachers. The kids are waiting.☐



THE MICRO IN A SMALL SCHOOL...

By Francis McGowan

A year later, it is still hard to believe, but we did get a computer at our high school. Teachers in the science and mathematics departments of our small midwestern high school began their campaign with the principal and superintendent, later presenting their case to the board of education. This is an extremely difficult time to request a large expenditure since the district is already plagued with reduced student enrollment, budget problems, and staff reduction. From the early attempts at securing a computer to the actual selection, purchase and implementation, it has been an interesting and definitely challenging experience for me. Perhaps some of the following will be of use to others who are contemplating a computer in their district.

Lake Central High School is located in Madison, South Dakota, a typical midwestern farming community with a population of about 6,500 people. Approximately 525 students are in grades 9-12. The computer campaign began nearly three years ago when we made the initial attempt to get a programming class started in the regular school curriculum by using an old but operating Olivetti P-101. Two years of looking at systems showed no success. Then in the spring of 1978 with the assistance of a computer coordinator from a nearby district, a demonstration computer was shown to the board of education. The explanation, along with a substantial discount, changed the board members' minds.

Digital Equipment Corporation's 50% discount for seccondary schools on their PDP 11V03 with two floppy disks certainly helped in convincing the board members that the time for computers in our education system had arrived. They voted unanimously in favor of the 11V03 with four terminals. The system would initially operate in MU BASIC. The cost to the district of the computer with two VT-50 video terminals and two LA-36 Decwriters was about $10,000 after the discount. According to one of DEC's salesmen, more than twice as many schools as anticipated took advantage of the offer. The hardware arrived in October, 1978 and the software installation was complete in early November.

The 56K bytes soon dwindled when the RT-11 and MU BASIC were bootstrapped and four terminals share what's left. We were left with about 1,900 words at each terminal, but the system is very flexible and it is possible to operate as only one terminal and all the memory. Part of the installed software was DEC's version 3B running in foreground-background monitor. This, with two floppies and four terminals, was quite slow. Patches and revisions are now coming forth to speed up the processes and reduce the number of interrupts. In the meantime, we were very fortunate in obtaining an older single-job version 1C from a college in North Dakota. This older version offers faster access to the disks and about half again as much memory per terminal.

Student interest and use grew proportionally with the number of programs available. Initial programs included finding a "hurkle" on a ten by ten grid or determining biorhythms. Currently, we have several hundred programs stored on floppies. Some students are quite proficient in writing programs, and many students want to know more. This interest is great considering our formal programming class won't start until this semester.

Our main group of users or potential users include the students, the teachers, the community, and the administration. As mentioned earlier, some of our students have become quite proficient in programming the 11V03. Probably the zenith of any single project so far was carried out by two physics students. It involved an energy use and projection analysis of the total amount of energy consumed and the cost over the past seven years and a projection for the next seven years. They developed programs to display graphically the current use and cost month by month, a second to project the future use and cost month by month, and another to represent these projections graphically.

Other student involvement includes using it to analyze data, solve or check problems, tutorials such as factoring trinomials, basic operations with signed numbers, or states and capitals, and learning to program in BASIC.

Recently two of the art classes completed a unit on computer art where each student had to write a successful program to show some object. Each of the programs were chained to the next so all thirty of the pictures would be produced in the final result. This was a great accomplishment for two reasons. It got a teacher outside the math and science departments involved, and many of the students who normally wouldn't get exposure to the computer did. This year the students in the secretarial block class (it meets two hours each day) spent time with the computer rather than as in the past where they read their data processing books and answered questions at the end of each chapter.

Many of the faculty in all grades are really excited about the 11V03 while still others even in the same building are unaware of its existence. An inservice workshop was offered to the staff in order to acquaint them with the potential. The response from it has been great. One elementary teacher brought her second grade students up for a field trip. Along with a picture of Snoopy or from Star Wars, they also had the opportunity to work on "ch" sounds that they had just covered in their class.

One of the speech therapists and I are working on a program to print out the individual presciptions for each of her ninety students after the diagnosis has been made. Currently, she is typing each of these out even though the prescriptions come from a group of about thirty combinations.

The community has had an opportunity to become involved through a ten-session "adult evening class." Sixteen people started the series, most of them business people with either a computer in their business or the possibility of one in the future. Two of the participants already owned TRS-80s.

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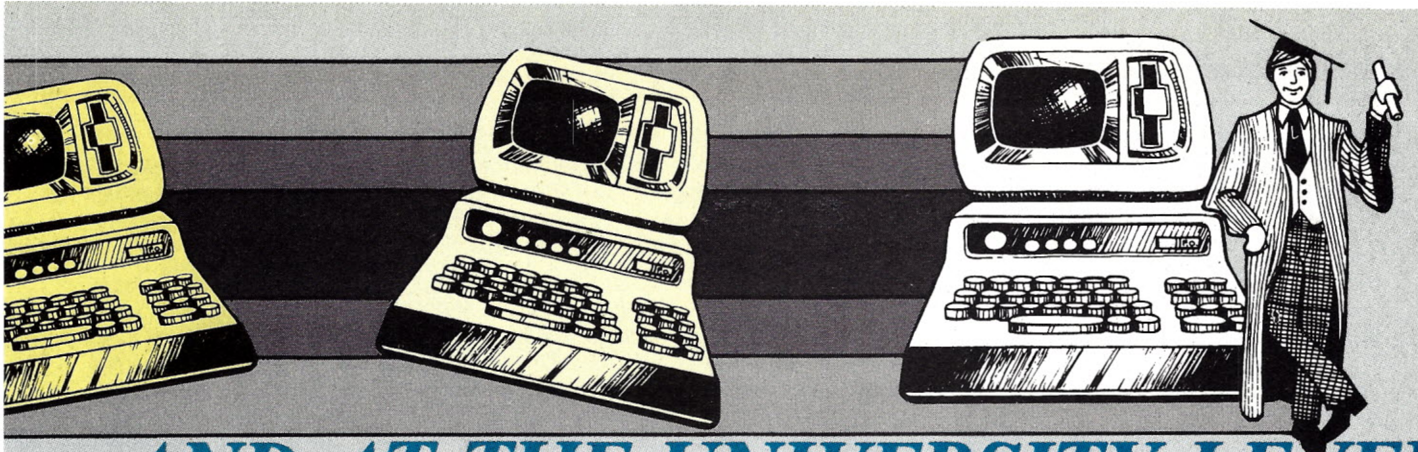


AND AT THE UNIVERSITY LEVEL

By Donald R. Scherer, Ph.D. Seton Hall University

Seton Hall University combines the use of microcomputers and a large timeshare unit, both of which are relatively new to the campus. The micros are used for business courses and for art and science courses (computer science theory and hardware interfacing). The timeshare system runs all the usual higher level languages, although assembly language is not available.

Approximately 600 of the 10,000 students take the introductory level computer science courses each semester, with about half of them taking additional courses in this field. There is currently a limit of 120 computer science majors, although this number is expected to be doubled this year.

MICROCOMPUTER TYPE

Several microcomputer hardware configurations were copied from successful minicomputers. The TMS 9900 CPU for the Technico "Educator" 900 series is so designed. It was taken from Texas Instruments' 990 minicomputer series. While microcomputer hardware is state-of-the-art, its software is still catching up. Of course, in mini-derived microcomputers some of the mini's software may be run on the microcomputer, but not all of it without a considerable upgrade in memory size and peripherals such as disk drives.

The Technico "Educator" 900 series was chosen because of its relatively large amount of EPROM-resident, on-board software. The EPROM allows for ease of change of the programs since each 920 board contains an EPROM programmer. Low initial investment plus add-on upgradeable systems means that the initial hardware need not be scrapped for new systems. Software considerations include a MONITOR and a resident interactive assembler in 2K bytes, and a small BASIC interpreter in 2K bytes. All of the above software is in four 2708 EPROM chips.

INSTANT INPUT ASSEMBLER

The Instant Input Assembler of the Technico "Educator" 900 microcomputer allows the student and educator to capitalize on a software dollar saving and at the same time to have hands-on use of a 69 instruction set complete computer. The IIA is an excellent teaching aid as well as a memory and cost saver. The IIA is stored in 1K bytes of EPROM. It does not have to be loaded, a push of the RESET and it and the MONITOR are ready to go. The 9900 series microcomputers are the only 16-bit microcomputers to contain an IIA. This gives them a time and dollar advantage, for it permits full assembly language computer programming with a minimum software cash outlay. For its small amount of memory space, it does have one disadvantage: it does not allow the use of labels. However, all addressing modes are available and one may use indexed, indirect, direct or auto-increment register addressing, plus direct, immediate and relative memory addressing.

Since the IIA may be entered by other programs, future student projects include the building in of labels to the IIA.

THE MICRO IN COMPUTER SCIENCE

At the university/college level, the Technico "Educator" 900 allows unrestricted student assembly language programming; that is, there is no need for a simulator or fear that the use of assembly language will allow the student access to security areas of the computer's files. The addition of an audio cassette tape interface allows the students to copy their own programs and to reload them at a later date, using their own personal tape recorders. Anyone who has tried to maintain removable equipment in a student environment realizes the value of this arrangement.

Since the 900 is a single board unit in its basic configuration and is packaged so that access to the integrated circuits is easily accomplished, its use in a computer hardware course is ideal. If a professor so wishes, he may place LEDs (light emitting diodes) at various points on the board to indicate logic levels. Also the clock may be easily slowed down to use with less expensive oscilloscopes of reduced bandwidth.

For introductory microcomputer courses, the 900 has been successfully used when introduced as a kit for the students to build. Very few assembly problems have been encountered and its kit cost for students has been very low, while offering all the advantages of being able to work with 16-bit minicomputer architecture.

THE MICRO IN OTHER CURRICULA

It would be hard to imagine a single board 900 for use in science, mathematics, or arts without first demanding student knowledge of assembly language programming. At this point in time that demand is not easily met, although the future might find this situation greatly changed. However, we live in the present and so cannot expect assembly language programming (or programming of any type) by the instructor.

We are thus limited to canned programs for such curricula, and good "courseware" is hard to come by.

The microcomputer, since it is mini-based will, given sufficient memory, run most of the programs now designed for minicomputers. With a disk and higher level language capability, the microcomputer will be able to be used for motivational purposes and Computer Assisted Instruction (CAI), including drill and practice sessions and simulation.

THE 900 COMPARED WITH OTHER MICROS

The attempt here is not to make a hardware comparison, but rather a comparison based on present educational needs. In considering a microcomputer for educational use, the following questions must be asked and answered, hopefully affirmatively:

1. What is the selected microcomputer's total cost, including power supplies, peripherals, if required, and software?
2. Is software, such as MONITORS, Operating Systems, Assemblers, etc., included in the above cost, or extra?

3. What is the cost of maintenance and how is it accomplished?
4. Is the selected microcomputer software and hardware expandable to meet foreseeable future needs?
5. Is it possible to establish a trial situation before going "full bore"?
6. Are educational materials available to teach the use of the selected microcomputer, or must it be gleaned from computer manuals?

As far as hardware structure, the LSI-11, the 8086, the 68000, the Z8000 and the NOVA are 16-bit configuration microcomputers, however, their comparable minimum hardware costs are much higher than the 900. The Z80, 8080, and 6800 based microcomputers are more fitted for hardware interfacing, rather than cost for a university computer science environment.

The Technico "Educator" does have a software cost advantage over other microcomputers in that it has a user-alterable on-board MONITOR and Assembler. The Assembler is perhaps the most important, since for other systems an assembler requires 8K bytes of memory and for some, a bit more. The LSI-11, the most costly microcomputer, does have the widest variety of software, but it must be purchased individually.

SPECIAL FEATURES

The Technico "Educator" 900 microcomputer fits all the criteria for an educational microcomputer. From the user's viewpoint it supports a full ASCII keyboard input and printer/CRT (20 ma loop, TTL, or EIA), with 50 to 9600 baud speed selectable by merely typing the letter "X" after pressing the RESET button. This provides for easy terminal interchange and acceptance of a wide variety of available terminals.

The 900 microcomputer has a MONITOR type operating system burned into the EPROM, so that it is always available and will not be accidentally erased. The MONITOR, in addition to the selectable baud rate mentioned above, contains eleven general purpose commands which allow the user (with a minimum of verbiage) to do such things as: execute programs, copy programs, edit existing programs, display the contents of memory and registers, put breakpoints into existing programs, program EPROM from memory, take snapshots of memory and registers at a given point in a program, and also do hexadecimal arithmetic. One final bonus of the MONITOR is that it is set up so that the user may incorporate into his own programs many of its I/O and other routines with a single instruction, thus saving programming time and memory space.

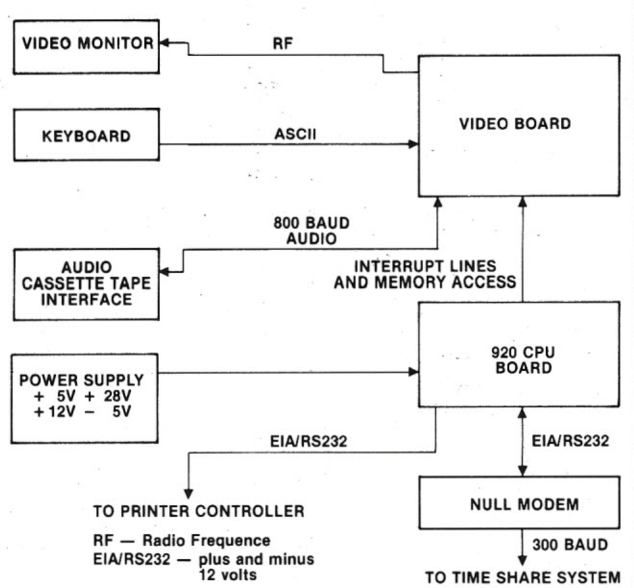


Figure 1. Block Diagram of a Student Microcomputer

The Instant Input Assembler is unique and especially valuable for educational use in that it is "interactive." What happens is that each assembly language instruction is immediately converted to machine language so that the student may readily see the one-to-one conversion occur, literally in front of his eyes. For the student, this greatly helps to establish the relationship between assembly language and machine language. Diagnostics are also included which indicate syntax, op code, and operand errors, demanding "on-the-spot" correction and immediate re-entry of the correct instruction.

OVERALL SYSTEM OPERATION

At present, six student microcomputers are in use. Since most student activity requires a written report to the professor, a single printer was included in the configuration. The 300 baud printer has been sufficient to handle the printing from six stations. Additional stations are planned to be added. For this heavier use, a faster printer and a spooling program will be added using the same hardware, namely an "Educator" 900 series microcomputer board and a higher speed printer. The individual student microcomputers are diagrammed in Figure 1.

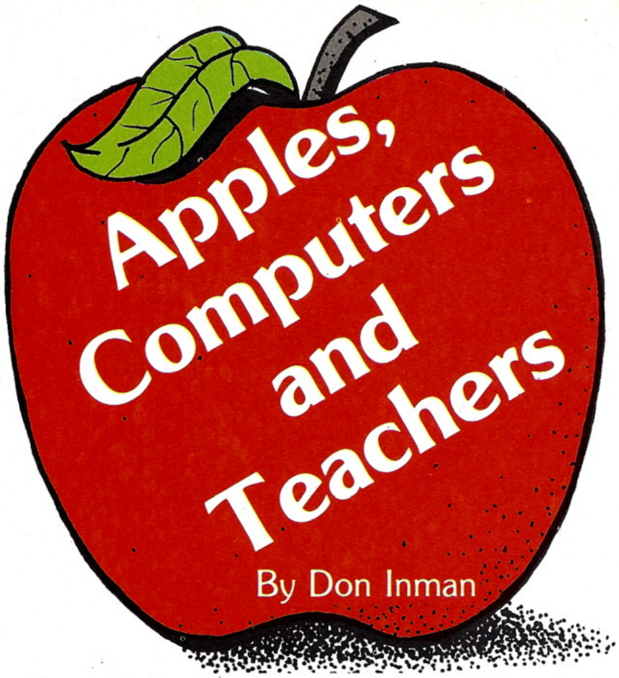
When the microcomputer is not being used directly, the student station may be used for access to the main time share computer. The microcomputer is not currently being used to implement a "smart" terminal. The reason for this now is that the main time share computer has more than sufficient capacity. However, should it reach a high percentage utilization, additional memory could be added at relatively low cost to the system. A second alternative is the addition of a larger Technico 9900 based system to run the Texas Instrument 990 minicomputer compilers for COBOL, FORTRAN and BASIC which are available from Texas Instruments.

The cassette tape recorder allows students to save their programs developed for the microcomputer as well as those from the time share system. This provides for a large amount of student program storage without burdening the disk/tape system of the time share computer. It has a hidden advantage for the student in that it provides security and encourages an early appreciation for file management and back-up procedures.

ADVANTAGES/DISADVANTAGES

The advantages of the microcomputer laboratory include low cost, flexibility to meet changing course load requirements, and total student control of a computer system. The only disadvantage is the requirement that the faculty have some members knowledgeable in and (perhaps, more important) interested in the hardware aspects of microcomputers. It has been found that student interest in hardware can easily be encouraged to provide practical technical support.

In summary, the microcomputer laboratory has provided additional hardware/software capability at a much lower cost than equivalent main frame capacity would provide. In real dollars and cents, the laboratory shown in Figure 1 (six student stations, and 300 baud printer), cost approximately $10,000 installed. The real benefits of the laboratory lie in increased student/faculty enthusiasm most probably generated by a feeling of "ownership." It is in reality, "theirs," not a loaned computer facility whose access may be denied by mere whim of another.☐



Apples, Computers and Teachers

By Don Inman

The Apple II computer is one of the most versatile computers for educational use. It may, in fact, intimidate the neophyte in his, or her, early contacts with the machine. Two forms of BASIC, as well as machine language, are immediately available to the user if the APPLESOFT pc card is inside the computer. Color graphics are provided in both high and low resolution modes, although there aren't as many colors for high resolution. Provision is also made for optional peripherals, many of which are readily available. In fact, it is Apple's many capabilities that sometimes frighten a beginner. And that doesn't mean the kids. They're totally unafraid and jump right in where a teacher fears to tread.

It is the teacher, however, who must be won over if we are to have universal instruction and universal use of computers in our schools. This is no easy task. After years of experience in education, I know that changes in this field come slowly and with much effort on the part of a few enterprising individuals. However, these exceptions (the enterprising ones) do exist, and they need all the encouragement that they can get.

Bobby Goodson, Computer Project Director in the Cupertino Union School District, is one of these exceptions. She recently conducted a 5-day workshop for teachers in Cupertino, California, through De Anza College. Fifteen teachers took part in the 3-hour per day workshop which was held in the Computer Center at Collins Junior High School. The workshop made use of five Apple II computers, three of which were obtained from funds supplied by a Title IVB federal grant. One of the Apples was purchased from MGM (Mentally Gifted Minors) funds, and the other was Goodson's own computer.

The project, funded under the ESEA Title IVC program, originated with the concern expressed by local industry, noting the lack of computer awareness and understanding in our schools. One of the sub-goals was to give interested staff members an opportunity to find out what a computer would do for them.

The Apple computer was chosen for the project because of a variety of reasons. Manufacturers were invited to demonstrate their products at the school at a common meeting. Costs were compared on the basis of a total system, not just the basic unit. Consideration was given to peripherals which might be added at a later time.

Recommendations favored the Apple in several respects, including:

Cost (when future additions were considered)
Color graphics
Availability of peripherals
Interest and support to education

The workshop for teachers utilized strings to introduce BASIC statements and programming techniques. The use of mathematical examples was avoided wherever possible. The background of the participants was largely non-mathematical.

The examples used strings similar to the following:

```
100 INPUT A$
110 B$ = "ANIMAL CRACKERS"
120 X$ = A$ + B$
130 PRINT X$
```

Instead of math examples such as:

```
100 INPUT N
110 M = 23.22
120 X = M + N
130 PRINT X
```

Computers in the past were considered to be the tools of mathematicians, scientists and business persons. The video display, which replaces paper output, is much more useful in many ways. It's a dynamic display which makes classroom applications lively and interesting.

The capabilities which the teachers in the workshop seemed to enjoy most involved string manipulations and graphics displays as in the following examples.

```
100 LET A$ = "STRINGS ARE MORE FUN"
110 LET B$ = "THAN ARITHMETIC!"
120 PRINT A$+B$
```

When introducing new statements, the use of strings is much more meaningful than contrived mathematical examples.

The program below reinforces previously discussed statements and concepts:

LET, INPUT, PRINT, GOTO, string variables
and long strings of characters.

It also is the first use of the MID$ statement *in a program.* MID$ had been previously used in the Immediate Mode.

MID$(variable, start, number)

variable	start	number
a string variable here	starting position for the sub-string within the string	the number of characters to be used in the string

An important technique in teaching beginners is to introduce only one new statement or concept at a time. Useful, interesting examples should be used for demonstration.

A PROGRAM TO PICK OUT HIDDEN WORDS IN A STRING

Emphasis on creative programs that avoid mathematics are more interesting than those depending on mathematics for program development:

```
100 HOME
110 LET A$ = "TEACHERS LOVE APPLES. ESPECIALLY
    APPLE COMPUTERS."
120 INPUT S,N
130 PRINT MID$(A$,S,N)
140 GOTO 120
```

One of the first applications of the above program was to use it to print out as many hidden words that could be found in the string A$.

Typical Resulting Word Lists

TEA	HERS
EACH	SPECIAL
A	ALL
ACHE	PUT
HE	COMPUTE
HER	COMPUTER

Such applications usually lead to other similar uses — either using previously learned statements or leading to the introduction of new statements. A good teacher takes advantage of these natural situations instead of relying completely on a pre-planned order of course content. In our particular situation, some of the workshop members wanted to pick out various sub-strings and concatenate (join) them to form new strings. This led to a natural review of MID$ (which had just been studied), LEFT$ and RIGHT$.

Instructors first experimented in the Immediate Mode, "playing" with the sub-string statements and studying the results. Typical "play-time" examples were:

A$="TEACHERS LOVE APPLES. ESPECIALLY APPLE COMPUTERS."

PRINT RIGHT$(A$,16)	Experimental request
APPLE COMPUTERS.	Computer's response
PRINT MID$(A$,10,4)	Start with 10th character, print 4
LOVE	
PRINT LEFT$(A$,8)	Print the 8 characters on the left
TEACHERS	

Participants were then asked to write programs using A$ that would print a sentence using sub-strings of their "play-time" examples. Here are typical programs and the results they printed.

```
100 HOME : SPEED=75
110 A$ = "TEACHERS LOVE APPLES. ESPECIALLY APPLE
    COMPUTERS."
120 PRINT LEFT$(A$,13);" ";RIGHT$(A$,16)
```

TEACHERS LOVE APPLE COMPUTERS. Result

```
100 HOME
110 A$ = "TEACHERS LOVE APPLES. ESPECIALLY APPLE
    COMPUTERS."
120 PRINT LEFT$(A$,9); MID$(A$,10,5); RIGHT$(A$,16)
```

TEACHERS LOVE APPLE COMPUTERS. Same result

```
100 HOME
110 A$ = "TEACHERS LOVE APPLES. ESPECIALLY APPLE
    COMPUTERS."
120 PRINT RIGHT$(A$,16)
130 PRINT MID$(A$,10,4)
140 PRINT LEFT$(A$,8)
```

APPLE COMPUTERS.
LOVE
TEACHERS

```
100 HOME
110 A$ = "TEACHERS LOVE APPLES. ESPECIALLY APPLE
    COMPUTERS."
120 PRINT RIGHT$(A$,16); MID$(A$,10,4); LEFT$(A$,8)
```

APPLE COMPUTERS.LOVETEACHERS

As you can see, some mistakes were made. An immediate opportunity is provided to discuss these mistakes and make corrections. Do not blindly proceed to the next subject when the one which was just covered is not properly understood.

Another Apple feature with interesting possibilities (often ignored) is the ability to vary the speed of the displayed output. Slow speeds can allow the user to actually see individual characters placed on the screen. Speeds can be changed during a program, and randomly selected speeds can be used.

Example: Alternating Lines at Different Speeds

```
100 HOME              }
110 SPEED = 150       }  Prints 40 asterisks
120 FOR X = 1 TO 40   }  in a row quickly
130 PRINT "*";        }
140 NEXT X            }
150 SPEED = 50        }
160 FOR X = 1 TO 40   }  Prints 40 X's
170 PRINT "X";        }  in a row slowly
180 NEXT X            }
190 GOTO 110          }  Then repeats
```

The Output:

```
****************************************
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
****************************************
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

etc.

Thus interesting patterns can be developed at different speeds. Another possibility for the speed feature might be in a reading program. Here is a simple example used in the workshop to introduce the concept.

```
100 PRINT
110 INPUT "WHAT SPEED (0-255)?"; S
120 HOME
130 SPEED = S
140 PRINT "YOU CAN VARY THE SPEED AT WHICH THIS"
150 PRINT "MESSAGE IS PRINTED. TRY NEW SPEEDS"
160 PRINT "TO INCREASE YOUR READING RATE."
170 GOTO 100
```

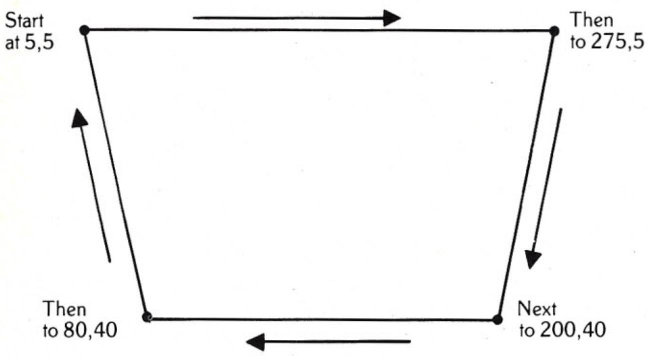
The program allows the user to input the speed at which he wants the reading matter to be displayed. The speeds run from 0 (the slowest) to 255 (the fastest).

Apple graphics, both high and low resolution, proved to be a popular choice for educational applications. HPLOT X,Y (in the high resolution mode) can be used to graph a point, along with HPLOT TO W,Z. This draws a line from the point specified by HPLOT to the point specified by HPLOT TO. The HPLOT TO statement avoids the need to calculate each point that the line passes through.

Example: Start at a Given Point and Draw a Geometric Figure

```
100 HOME: HGR          Clear screen and set high res.
110 HPLOT 5,5          Start here
120 HPLOT TO 275,5     Draw to here
130 HPLOT TO 200,4     Continue to here
140 HPLOT TO 80,4      Keep going to here
150 HPLOT TO 5,5       And back to beginning
```

Result:

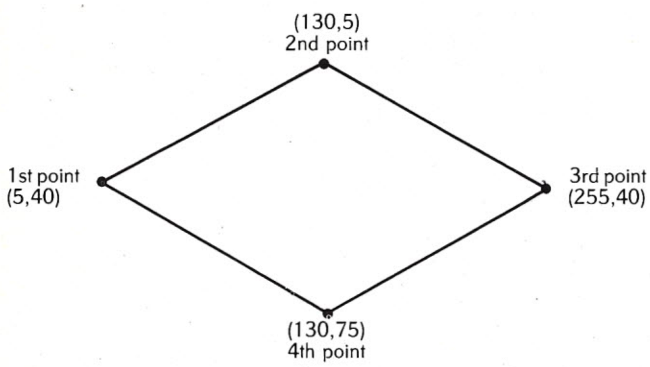


A series of straight lines may be plotted by the HPLOT statement in a much more condensed form in the following way.

Example:

```
100 HOME: HGR
110 HPLOT 5,40 TO 130,5 TO 255,40
120 HPLOT TO 130,75 TO 5,40
```

This produces a similar result:



Wouldn't it be nice to be able to vary the speed of the displayed points when drawing a design or picture? Unfortunately, the speed function only works with the printing of text material. So don't try it when using the graphics mode. In the latter case, it will only have an affect on the text displayed in the text window.

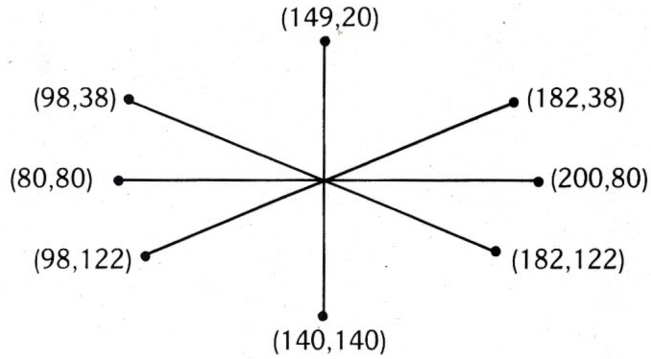
Of course, everyone likes to experiment with Apple color. Suggested is a simple program that can readily be modified by the user. The example that follows draws a simple design in various colors. It uses a DATA list that can be modified at will and a READ statement to get new data.

COLORED SPOKES IN A WHEEL

```
100 HOME: HGR              High resolution
110 FOR X = 1 TO 8
120 READ A,B,C
130 HCOLOR = C             Color range, 0-7 (0 & 4 are black)
140 HPLOT 140,80 TO A,B      Gives time delay plus
150 FOR Y = 1 TO 21:           puts cursor at text window
160 NEXT Y
170 NEXT X

200 DATA 200,8,1,182,38,2,140,20,3        In order; A,B,C
210 DATA 98,38,5,80,80,6,98,122,7
220 DATA 140,140,7,182,122,1
```

The colored spokes look something like this:

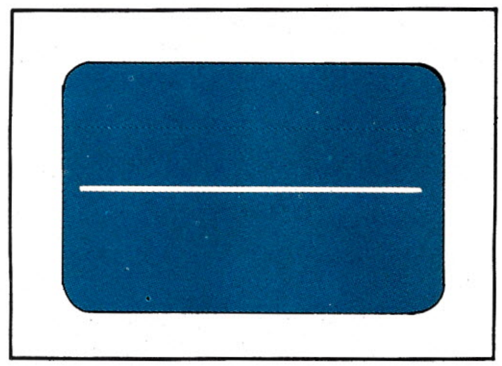


Another Apple feature that teachers enjoyed and spent much time working with was the vertical and horizontal line drawing capability.

The statement:

```
                                  start with this column
HLIN 0,39 AT 20 ← at this row
                                  end with this column
```

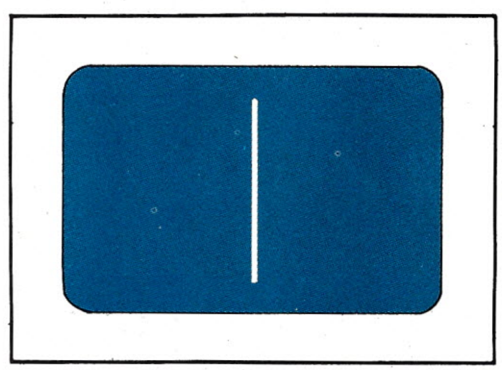
will draw a Horizontal LINe all the way across the screen, about half way down.



The statement:

```
                                  start at this row
VLIN 5,42 AT 20 ← at this column
                                  end at this row
```

will draw a Vertical LINe about half-way across the screen, from near the top to near the bottom.



A test of the user's ability to use the line drawing feature was to have them try to draw a rectangle by connecting four of these lines in the Immediate Mode.

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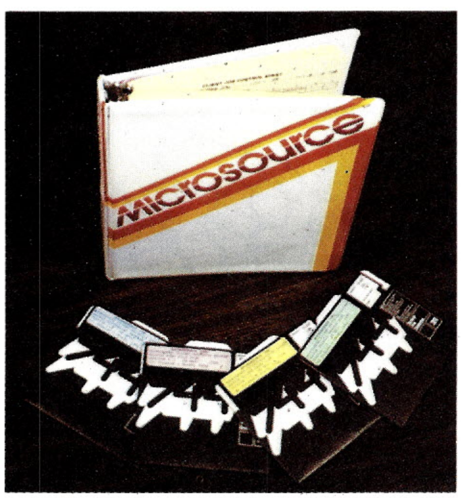

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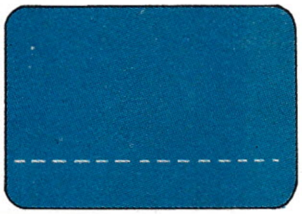
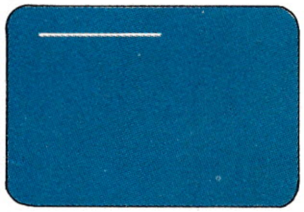
Example: Draw a rectangle starting at the point (3,5)

STATEMENT **DISPLAY**

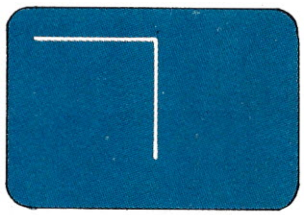
GR Set low res. graphics
HOME Clear screen and home cursor
COLOR = 5 Set color



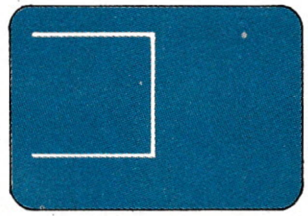
HLIN 3,20 AT 5 top line



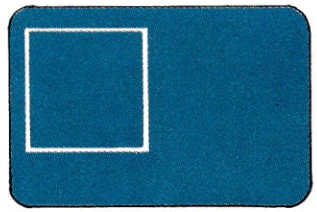
VLIN 5,39 AT 20 right side



HLIN 20,3 AT 39 bottom



VLIN 39,5 AT 3 left side



A few of the more advanced participants had time to do some preliminary investigation of high resolution graphics. A typical application was reproducing a map of a given state with the location of its capitol indicated on the map. At the end of the course, one teacher was constructing a quiz of state capitols, with the state map and capitol location being the only clues provided.

Many students have computers in their homes or have access to one in the home of a friend. Computers are beginning to appear in libraries and recreational centers. It is only a matter of time until they become even more common.□

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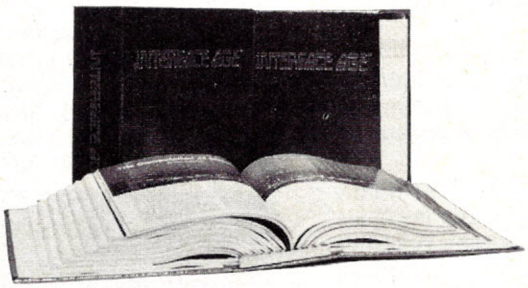

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TEACHER: The Classroom Record Keeper

By Richard Lemon and Craig Jones
AJA Software
P.O. Box 2528, Orange, CA 92669

Record keeping, whether it's for a multi-million dollar corporation or for a local bridge club, can become cumbersome and ineffectual if handled incorrectly. This record trauma is particularly true in the area of education, where teachers have multiple duties that include the creation and maintenance of student records.

There is, however, a fortunate side to the record keeping problem of teachers: the most important records are student contact information and test results, which lend themselves to computerization quite easily.

The program described in this article is designed to provide the classroom teacher with the ability to save important information regarding a student such as the address, and any vital notes and, of course, all important test data. The program is designed to work on a Radio Shack TRS-80 Model I computer system with dual disks and at least 32K of memory.

STRUCTURE OF THE SYSTEM

The program called TEACHER is made up of four different programs or segments. Each segment is designed to perform a specific function, and each segment is dependent upon the other in some manner.

The first program segment, Listing 1, is called GRADING. It is, as the top notes show, the control program for the entire system. This is the first program called and is invoked by entering: RUN "GRADING". The TRS-80 will respond with a display similar to that shown in screen response number 1.

```
GRADING — STUDENT GRADING CONTROL PROGRAM

(P) SYSTEMS PARAMETERS MAINTENANCE

(S) STUDENT MASTER FILE MAINTENANCE

(#) SCORES ENTRY/MAINTENANCE

(B) BASIC LEVEL            (D) DOS LEVEL

ENTER PROGRAM ID
```

SCREEN RESPONSE 1

You will notice that you are given various choices for what you want to do. For example, entering the letter B will cause a BASIC NEW command to be issued — Line 202. The current program will be erased and you will be in BASIC's command level. Entering D performs a similar function, except that it puts the system into the DOS — Disk Operating System level by issuing a system command 'S'. Both these inputs are allowed to give the user flexibility with the TRS-80 system.

```
(1) AREA CODE           213


(2) DRIVE NUMBER        :1


CHANGE WHICH LINE:      /<NONE/  ?
```

SCREEN RESPONSE 2

The three other commands: P, S and # are used to call one of the three program segments SYSGEN, STUDENT, or SCORING.

The entry of the letter P will cause BASIC to find the word SYSGEN in the DATA Statements in Line 300 and RUN that program. This program, Listing 2, will cause a display as shown in screen response number 2.

The purpose of SYSGEN (system generator) is to make it possible to set up default values for the system to use later. The first is: AREA CODE. For example, 90% of your students may live in the 303 area code. By setting this default to 303, you do not need to key it in when the area code is requested. The Drive number refers to which data drive you select to put the diskette on to hold the database. (Please refer to the Radio Shack operations manual regarding diskette initialization.) Because area codes and system setups do change, the ability to change these values is provided.

```
STUDENT MASTER FILE MAINTENANCE


PLEASE PLACE THE STUDENT GRADING DATA IN

DRIVE #1 AND HIT <ENTER>.........
```

SCREEN RESPONSE 3

The next program segment available in TEACHER is STUDENT. This program, Listing 3, is called by entering the letter S while in the system menu. When this program segment is first called, a display similar to that shown in screen response 3 results. This message is provided to ensure that you have a data disk in the appropriate drive. On depressing the RETURN key the system will display another menu like the one shown in screen response number 4.

```
COMMANDS ARE:
1 LOOK-UP ONLY (NO ACTION)
2 MAINTENANCE
3 REMOVE STUDENTS
4 ADD STUDENTS
5 PRINT STUDENT ROSTER
9 END OF JOB
ENTER COMMAND NUMBER 101:
```

SCREEN RESPONSE 4

Because the maintenance part of TEACHER is so extensive, the menu function is used to provide maximum flexibility to the user. Five options exist. The fifth option call is for entering the number 9. This makes it possible for the user to end the session and return to the system menu to perform some other function. Entry of any other numbers offers the named function. LOOK-UP does what its name implies by providing the ability to look for a specific student by student number. When a correct or existing number is in the computer, the system responds with a display of the record. See screen response number 5.

```
(1) STUDENT NUMBER:               100
(2) NAME:                         JACK LONG
(3) ADDRESS:                      1422 ELM
(4) CITY, STATE & (5) ZIP:        AURORA, CO 80010
(6) AREA CODE & (7) PHONE:        (303) 861-9991
(8) EMERGENCY
     INFORMATION/NOTES:           EMR # (303) 222-2222 FATHER
```

SCREEN RESPONSE 5

Other menu functions include MAINTENANCE, which makes it possible to change parts of the record except student number. REMOVE STUDENTS removes a student's record by writing a zero into the student number. *Note:* when a record is removed, the record will still show up on the student roster until a new record is written onto the disk in its place.

The ADD STUDENTS function does just that. The user can add students to the database by asking specific questions generated from lines 3000-3390.

The final system function is PRINT STUDENT ROSTER. This function causes the system to print the entire student database as shown in Figure 1. Notice that all the information that was entered about the student is printed on this report.

```
STU# NAME          ADDRESS                  CITY/STATE      ZIP   PHONE
-------------------------------------------------------------------------
 100 BILL SMITH    1234 TREE ST             LOMA LINDA,CA   90505 (213) 231-1684
                   CONTACT FATHER AT (213) 652-1800
 101 IRMA BISHOP   5562 WILSON AVE          TORRANCE,CA     90503 (213) 878-1403
                   MOTHER WORKS (213) 686-4000
 102 HI VANDEEN    54 ACE LANE              TARZANA,CA      90001 (213) 646--313
                   DIABETIC TENDENCY TO FORGET INSULIN
 103 ZELDA MURPHY  1000 LARCH ST APT 13     INGLEWOOD,CA    90005 (213) 926-9543
                   CONTACT NEIGHBOR (213) 883-9500
 104 BOBBY JONES   16704 MARQUARDT AVE      CERRITOS,CA     90701 (213) 926--954
                   ALLERGIC TO CRAZY EDITORS
```

Figure 1.

Once all the basic student information is entered, the teacher will want to attach grade information to each student. This is performed by entering the number symbol (#) to the input request on the system menu. The system will display the response shown in screen response number 6. Notice that a menu is used again to offer the various options.

```
COMMANDS ARE:

1 ENTER SCORES
2 SCORE MAINTENANCE
3 PRINT REPORT
4 END OF JOB

ENTER COMMAND NUMBER
```

SCREEN RESPONSE 6

The SCORING program, Listing 4, works much the same as the STUDENT program by referencing the student number. The important thing about this program is that it allows the teacher to set up the scoring by unit or individual tests and establish individual weighting to each test — Lines 1000-1110. The program will use this information for determining curves by calculating the percentages earned and the standard deviation, Lines 3000-3220. The SCORING program also prints a report, Figure 2, that gives the student number, the unit or test numbers and the totals and score percentages. The total scores and weighting are printed along with the averages and standard deviation. The purpose is to provide the teacher with information on how to correctly establish a grading curve.

```
STUDENT                   TOTAL
NUMBER   UNIT 1  UNIT 2 SCORE    PERCENTAGE
  100     45.0    67.0 %1095.0     75.0
  101     95.0    56.0 %1030.0     70.5
  102    100.0    84.0 %1460.0    100.0
  103     23.0    68.0 %1066.0     73.0
  104     86.0    81.0 %1387.0     95.0

TOTAL    349.0   356.0
AVERAGE   69.8    71.2 %1207.6     82.7
STN DEV   34.0    11.4 283.0       19.4
POSSIBLE100.0    84.0 %1460.0
```

Figure 2.

FUNCTIONAL PARTS OF TEACHER

Taking a close look at the four listings, you will find that all the FIELDing functions of the program are handled in the lines numbered 5000. These lines are used to set up the FIELD specifications and define the various variables used in the programs.

Also of importance is the number of students that the system can accommodate. Assuming a two disk system with one dedicated data disk and two data files: STUDENT/DTA* and SCORES/DTA* which establishes one record type per student, approximately 502 student records can be stored on one diskette.

This program, taken as a whole, is meant as a bare bones system to provide a modicum of record keeping capability to the classroom teacher. Notice that the program is modular in design, making it flexible for upward expansion of other capabilities such as sorting by student number or zip code. Other functions can also be built in such as help messages utilizing HELP files to guide the novice user through the system.

HOW THE LISTINGS WERE PREPARED

As you have been reading this article, you have probably noticed that the listings were printed in an unusual manner: lines appear to be a predetermined length, 72 characters and sub lines are indented.

This was accomplished by using a program which we call PRETTY. This allows us to create listings that are easy to read. One difference you will immediately notice is that when a line is truncated (shortened), a slash (\) is printed as a flag and is not part of the original line.

Both TEACHER and PRETTY are programs that are not only functional in purpose but show the extreme flexibility of the Radio Shack system.□

Program follows

*These are the data file names. See Radio Shack manual for further explanation.

LISTING 1

```
 10            GRADING - STUDENT GRADING CONTROL PROGRAM
 20             WRITTEN BY CRAIG L. JONES, AJA SOFTWARE
 30             MAY 19, 1979  FOR INTERFACE AGE MAGAZINE
 40 PRINT CHR$(15):
    CLS
 50 PRINT @64,"GRADING - STUDENT GRADING CONTROL PROGRAM"
 70 PRINT @256,"(P) SYSTEMS PARAMETERS MAINTENANCE"
 80 PRINT "(S) STUDENT MASTER FILE MAINTENANCE"
 90 PRINT "(#) SCORES ENTRY/ MAINTENANCE"
100 PRINT:
    PRINT "(B) BASIC LEVEL         (D) DOS LEVEL":
    PRINT
110 PRINT "ENTER PROGRAM ID: "; CHR$(14);
200 N$=INKEY$:
    IF LEN(N$)=0 THEN 200
202 IF N$="B" NEW
204 IF N$="D" CMD "S"
210 N=INSTR("PS#",N$):
    IF N=0 THEN 40
220 FOR I=1 TO N:
      READ N$:
    NEXT I:
    PRINT CHR$(15);N$:
    RUN N$
300 DATA "SYSGEN","STUDENT","SCORING"
```

LISTING 2

```
10       SYSGEN - SYSTEM PARAMETERS GENERATION AND MAINTENANCE
11              WRITTEN BY CRAIG L. JONES, AJA SOFTWARE
12                  MAY 19, 1979  FOR INTERFACE AGE
13 CLEAR 200:
   CLS:
   DEFINT A-Z
15 DEF FNSP$(X)=">"+STRING$(X," ")+"<"+STRING$(X+1,CHR$(24))
17 PRINT "SYSGEN - SYSTEM PARAMETERS MAINTENANCE"
18 ON ERROR GOTO 19:
   OPEN "I",1,"PARAM/DTA:0":
   CLOSE:
   ON ERROR GOTO 0:
   GOTO 25
```

LISTING 3

```
   5     MAINT - STUDENT FILE MAINTENANCE - STUDENT GRADING SYSTEM
   8   WRITTEN BY RICHARD M. LEMON & CRAIG L. JONES - A.J.A. SOFTWARE
   9                            19 MAY 1979
  10 CLEAR 500:
     DEFINT A-Z:
     CLS
  15 DEF FNSP$(X)=">"+STRING$(X," ")+"<"+STRING$(X+1,CHR$(24))
  31 GOSUB 8500
  32 PRINT "STUDENT MASTER FILE MAINTENANCE":
     PRINT
  33 PRINT "PLEASE PLACE THE STUDENT GRADING DATA DISK IN"
  34 PRINT "DRIVE #"; RIGHT$(DV$,1);" AND HIT <ENTER>.........";:
     LINE INPUT X$
  35 OPEN "R",1,"STUDENTS/DTA"+DV$
  40 GOSUB 4500
  50 CM=0:
     INPUT "ENTER COMMAND NUMBER /0/: ";CM
  60 IF CM=9 THEN 9000
  62 IF CM=5 THEN 2400
  65 CLS
  70 S=1:
     NW=0:
     BAD=0
  80 GOSUB 3000
  90 IF NU=0 THEN 40
  95 GOSUB 6000
  96 IF BAD
       IF CM<4 PRINT "NO SUCH STUDENT !!":
         GOTO 70
  97 IF CM<>4 GOSUB 4000
 130 ON CM GOTO 70,2100,2200,2300
 140 PRINT ">>>>  INVALID COMMAND  <<<<"
2100                                                          MAINTENANCE
2120 IF NOT BAD THEN 2130
2122 X$="N":
     LINE INPUT "IS THIS A NEW STUDENT? (Y/N) /NO/: ";X$
2124 IF LEFT$(X$,1)="Y" THEN 2300
     ELSE 70
2130 S=0:
     INPUT "ENTER ITEM NUMBER TO CHANGE: /<ALL CORRECT>/ ";S
2135 IF S=0 THEN 2160
2137 IF ABS(S)=1 PRINT "TO CHANGE THE STUDENT NUMBER YOU MUST REMOVE \
       \AND REENTER THE":
       PRINT "ENTIRE DATA SET.":
       GOTO 2130
2140 GOSUB 3000
2150 GOTO 2130
```

```
  19 RESUME 20
  20 OPEN "R",1,"PARAM/DTA":
     GOSUB 5000:
     L=-1:
     GOSUB 3000:
     GOSUB 6000:
     GOTO 50:
  25 OPEN "R",1,"PARAM/DTA"
  30 GOSUB 5000
  40 GOSUB 5014
  50 GOSUB 4000
  60 L=0 :
     INPUT "CHANGE WHICH LINE:  /<NONE>/ ";L
  70 IF L=0 THEN 100
  80 GOSUB 3000
  90 GOTO 50
 100 GOSUB 6000
 110 CLOSE
 120 RUN "GRADING"
3000 ON ABS(L) GOTO 3100,3200
3010 PRINT "BAD LINE NUMBER"
3020 RETURN
3100 INPUT "ENTER YOUR AREA CODE: ";PA
3110 IF PA>999 THEN 3100
3120 IF L>0 RETURN
3200 DV$="":
     LINE INPUT "ENTER DRIVE NUMBER /<ANY>/: ";DV$:
     IF LEN(DV$)=1 OR LEN(DV$)>2 THEN 3200
3210 IF LEN(DV$)=0 RETURN
3220 IF LEFT$(DV$,1)<>":" OR V@L(RIGHT$(DV$,1))>3 AND DV$<>":0" THEN \
      \3200
3999 RETURN
4000                                          PRINT OUT PARAMETERS
4005 CLS
4010 PRINT "(1) AREA CODE:              ";PA
4020 PRINT "(2) DRIVE NUMBER:           ";DV$
4130 RETURN
5000                         FIELD 'PARAM/DTA' AND FILL VARIABLES
5010 FIELD 1,2 AS PA$,2 AS PD$
5012 RETURN
5014 GET 1,1
5020 PA=CVI(PA$):
     DV$=PD$
5030 IF DV$="  " THEN DV$=""
5050 RETURN
6000                                  PUT PARAMETERS BACK IN FILE
6010 LSET PA$=MKI$(PA):
     LSET PD$=DV$
6040 PUT 1,1
6050 RETURN
```

```
2160 GOSUB 7000
2170 GOTO 70
2200                                                     REMOVAL
2220 IF BAD PRINT "NO SUCH STUDENT !!":
       GOTO 70
2230 LINE INPUT "PLEASE VERIFY REMOVAL (Y/N) /YES/: ";A$
2240 IF LEFT$(A$,1)="N" THEN 70
2250 NU=0
2260 GOSUB 7000
2270 GOTO 70
2300                                            STUDENT ADDITION
2301 IF NOT BAD PRINT "THIS STUDENT NUMBER ALREADY EXISTS...":
       GOTO 70
2303 NW=-1   'NEW
2305 IF LOF(1)=0 THEN L1=1:
       GOTO 2340
2307 IF L7>0 THEN L1=L7
     ELSE L1=LS+1
2340 S=-2:
     GOSUB 3000
2350 GOSUB 5000:
     NW=(L7=0):
     GOSUB 7000
2360 GOTO 70
2400                                        PRINT STUDENT ROSTER
2410 PF=-1  'PRINT FLAG
2420 LINE INPUT "SET PAPER AND TYPE <ENTER>: ";X$
2430 LPRINT "STU#  NAME                       ADDRESS                  CI\
     \TY/STATE           ZIP   PHONE"
2440 LPRINT "------------------------------------------------------------\
     \---------------------------------------"
2450 GOSUB 6000
2460 PF=0:
     GOTO 40
2470                                     STUDENT DATA LINE PRINT
2480 LPRINT USING "##### %                          %%                    \
     \   %%               %##### (###) ###!####";M0,MN$,MA$,MC$,CVS(\
     \MZ$),CVI(MR$),CVI(MP$),"-",CVI(MS$)
2490 IF ME$<>STRING$(44,32) LPRINT STRING$(31,32);ME$
2500 RETURN
3000                                ROUTINE TO ENTER INFORMATION
3010 ON ABS(S) GOTO 3030,3045,3080,3120,3160,3192,3194,3200
3020 PRINT ">>>>>>>    BAD SELECTION    <<<<<<<<":
     RETURN
3030 NU=0:
     INPUT "ENTER STUDENT NUMBER: /<NONE>/ ";NU
3040 IF S>0 RETURN
3045 NA$=""
3050 PRINT "INPUT STUDENT'S NAME: "; FNSP$(25);
3055 LINE INPUT NA$
3060 IF LEN(NA$)>25 THEN 3045
```

Program continued on Page 80

DIGITAL RESEARCH

Software with Manual / Manual Alone

- ☐ **CP/M* Floppy Diskette Operating System** — Packages supplied on diskette complete with 8080 assembler, text editor, 8080 debugger and various utilities plus full documentation. CP/M available configured for most popular computer/disk systems including: North Star Single, Double or Quad density, Altar 8" disks, Helios II, Exidy Sorcerer, Vector MZ, PolyMorphic 8813†‡ Heath H17† or H89†, TRS-80†, iCOM 3712 and iCOM Micro Disk plus many other configurations available off the shelf .... **$145/$25**
- ☐ **MAC** — 8080 Macro Assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Z-80 library included. Produces Intel absolute hex output plus symbols file for use by SID (see below) .... **$100/$15**
- ☐ **SID** — 8080 symbolic debugger. Full trace, pass count and break-point program testing system with back-trace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values .... **$85/$15**
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  .... Version 3, **$650/$50**
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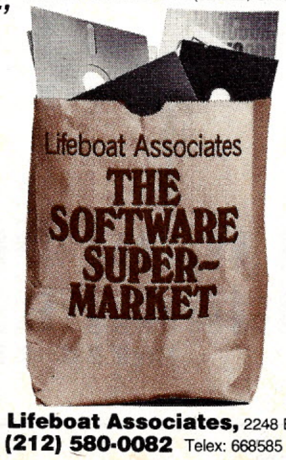

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All items listed below operate in conjunction with the CPM operating system.

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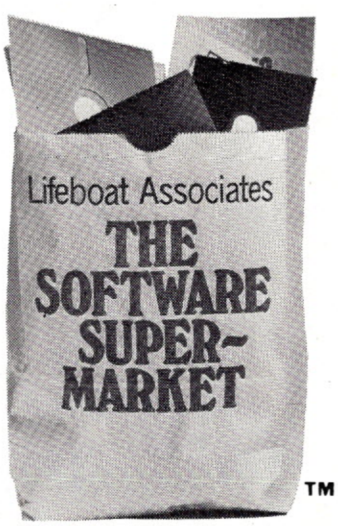

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```
3070 IF S>0 RETURN
3080 AD$=""
3085 PRINT "STUDENT'S ADDRESS:     "; FNSP$(25);
3090 LINE INPUT AD$
3100 IF LEN(AD$)>25 THEN 3080
3110 IF S>0 RETURN
3120 CS$=""
3125 PRINT "STUDENT'S CITY, STATE:      "; FNSP$(20);
3130 LINE INPUT CS$
3140 IF LEN(CS$)>20 THEN 3120
3150 IF S>0 RETURN
3160 ZP!=0
3170 INPUT "ENTER STUDENT'S ZIP CODE: ";ZP!
3180 IF ZP!>99999 THEN 3160
3190 IF S>0 RETURN
3192 PA=DA:
     PRINT "AREA CODE  /";PA;"/:  ";:
     INPUT PA
3193 IF PA>999 THEN 3192
     ELSE
       IF S>0 RETURN
3194 PP=0:
     PS=0:
     INPUT "ENTER TELEPHONE NUMBER (NO HYPHEN)";A$
3196 PP=VAL(MID$(A$,1,3)):
     PS=VAL(MID$(A$,4,4))
3198 IF S>0 RETURN
3200 EI$="":
     PRINT "ENTER EMERGENCY INFORMATION OR OTHER NOTES:":
     PRINT FNSP$(44);:
     LINE INPUT EI$:
     EI$=LEFT$(EI$,44)
3390 RETURN
4000 REM ROUTINE TO PRINT OUT CURRENT STUDENT STATUS
4010 CLS
4020 PRINT "(1) STUDENT NUMBER:          #";NU
4030 PRINT "(2) NAME:                     ";NA$
4040 PRINT "(3) ADDRESS:                  ";AD$
4050 PRINT "(4) CITY, STATE & (5) ZIP:    ";CS$;ZP!
4060 PRINT "(6) AREA CODE & (7) PHONE:    ";
4070 PRINT USING "(###) ###!####";PA,PP,"-",PS
4080 PRINT "(8) EMERGENCY INFORMATION/ NOTES: ";EI$
4110 PRINT:
     RETURN
4500 CLS:
     PRINT "COMMANDS ARE:":
     PRINT
4510 PRINT "1. LOOK-UP ONLY (NO ACTION)"
4520 PRINT "2. MAINTENANCE"
4530 PRINT "3. REMOVE STUDENTS"
4540 PRINT "4. ADD STUDENTS"
4545 PRINT "5. PRINT STUDENT ROSTER"
```

```
     ZP!=CVS(MZ$)
6140 PA=CVI(MR$):
     PP=CVI(MP$):
     PS=CVI(MS$):
     EI$=ME$
6150 RETURN
6500                                          STORE DATA INTO FILE
6510 GOSUB 5000
6520 IF P0<>P1 GET 1,P1:
       P0=P1
7000 LSET M0$=MKI$(NU):
     LSET MN$=NA$:
     LSET MA$=AD$
7010 LSET MC$=CS$:
     LSET MZ$=MKS$(ZP!):
     LSET ME$=EI$
7040 LSET MR$=MKI$(PA):
     LSET MP$=MKI$(PP):
     LSET MS$=MKI$(PS)
7050 PUT 1,P1
7060 IF NOT NW RETURN     'NW= NEW
7070 FIELD 1, 2 AS C$
7080 GET 1,1
7090 LSET C$=MKI$(L1)
7100 PUT 1,1
7110 RETURN
8500                           LOAD PARAMETERS FROM 'PARAM/DTA' FILE
8510 OPEN "R",1,"PARAM/DTA"
8520 FIELD 1,2 AS PA$, 2 AS DV$
8530 GET 1, AS DV$
8530 GET 1,1
8540 DA=CVI(PA$)   'DEFAULT AREA CODE
8550 DV$=DV$        'DRIVE NUMBER APPENDAGE (THIS STATEMENT SEEMS TO BE\
     \ REDUNDANT BUT IT REDEFINES DV$ TO BE A REGULAR STRING VARIABLE  \
     \          (NON-FIELDED))
8560 CLOSE 1
8570 RETURN
9000 CLOSE
9010 RUN "GRADING"
```

LISTING 4

```
10        SCORING - SCORES MAINTENANCE - STUDENT GRADING SYSTEM
20              WRITTEN BY CRAIG L. JONES, A.J.A. SOFTWARE
30               MAY 19, 1979  FOR INTERFACE AGE MAGAZINE
35                                                  INITIALIZATION
40 CLEAR 500:
   DEFINT A-Z:
   CLS
42 DIM SN(669)   'VALID STUDENT NUMBERS
44 GOSUB 8500:
   GOSUB 8700
```

```
4550 PRINT "9. END OF JOB"
4560 PRINT:
     RETURN
5000                        ROUTINE TO SET FIELD SPECS FOR "STUDENTS/DTA"
5010 P1=INT((L1+1)/2) 'COMPUTE PHYSICAL RECORD NUMBER
5020 S1=L1-2*P1+1      'COMPUTE POSITIONING WITHIN PHYSICAL RECORD
5030 FIELD 1, (2+126*S1) AS DUMMY$,2 AS M0$, 25 AS MN$, 25 AS MA$, 20 A\
     \S MC$, 4 AS MZ$, 2 AS MR$, 2 AS MP$, 2 AS MS$, 44 AS ME$
5040 RETURN
5100 REM THE VARIABLES CHOSEN FOR USE IN THE FIELD STATEMENT ALL BEGIN\
     \
5110 REM        WITH M (MASTER) SO THAT THEY WOULDN'T BE CONFUSED WITH\
     \
5120 REM        THE ACTUAL VARIABLES WITHIN THE BODY OF THE PROGRAM.
5130 REM
5140 REM M0 - STUDENT NUMBER
5150 REM MN - STUDENT NAME
5160 REM MA - ADDRESS
5170 REM MC - CITY & STATE
5180 REM MZ - ZIP CODE
5190 REM MR - AREA CODE
5200 REM MP - PHONE NUMBER PREFIX
5210 REM MS - PHONE NUMBER SUFFIX
5220 REM ME - EMERGENCY INFORMATION AND NOTES
5990 REM
6000                         RETREIVE RECORD FROM FILE AND FILL VARIABLES
6003 BAD=-1:
     L7=0  'BAD= STUDENT DOES NOT EXIST, L7= FIRST AVAILABLE SUB RECORD\
     \
6005 IF LOF(1)=0 THEN LS=0:
       GOTO 6050
6010 FIELD 1,2 AS C$
6020 GET 1,1:
     LS=CVI(C$)  'LS= LOGICAL RECORD NUMBER OF LAST USED SUB RECORD
6050 FOR L1=1 TO LS
6060   GOSUB 5000
6065   IF LS=0 RETURN
6070   IF P0<>P1 GET 1,P1:
         P0=P1      'P0= CURRENT RECORD, P1= DESIRED RECORD
6075   M0=CVI(M0$)
6077   IF PF GOSUB 2480:
         GOTO 6090  'PF=PRINT FLAG
6080   IF NU=M0 THEN 6110    'FOUND STUDENT ENTRY
6085   IF M0=0
         IF L7=0 THEN L7=L1
6090 NEXT L1
6100 RETURN
6110 BAD=0
6120 NA$=MN$:
     AD$=MA$:
     CS$=MC$:
```



```
  45 NF$="###.# "
  50 PRINT @64,"SCORES - SCORES MAINTENANCE":
     PRINT
  60 ON ERROR GOTO 100:
     OPEN "I",1,"SCORES/DTA"+DV$:
     ON ERROR GOTO 0:
     CLOSE:
     OPEN "R",1,"SCORES/DTA"+DV$:
     GOSUB 8100:
     GOTO 200
 100 RESUME 105
 105 ON ERROR GOTO 0:
     OPEN "R",1,"SCORES/DTA"+DV$:
     GOSUB 8000
 190                                                  COMMAND ENTRY
 200 PRINT "COMMANDS ARE:"
 210 PRINT "1. ENTER SCORES"
 220 PRINT "2. SCORE MAINTENANCE"
 230 PRINT "3. PRINT REPORT"
 240 PRINT "9. END OF JOB"
 250 INPUT "ENTER COMMAND NUMBER: ";CM
 260 IF CM=9 THEN 9000
 280 ON CM GOSUB 1000,2000,3000
 290 GOTO 200
1000                                                 SCORE COLUMN ENTRY
1010 LINE INPUT "ENTER COLUMN NAME /<NONE>/: ";CN$
1020 IF LEN(CN$)=0 THEN 200
1030 FOR CLMN=0 TO CU:
       IF CN$=CN$(CLMN) THEN 1070
1040 NEXT CLMN
1050 LINE INPUT "IS THIS A NEW COLUMN (Y/N) /N/: ";X$:
     IF LEFT$(X$,1)<>"Y" THEN 1010
1060 CU=CU+1:
     CLMN=CU:
     CN$(CLMN)=CN$:
     REP=-1:
     GOTO 1080
1070 LINE INPUT "ADD TO PREVIOUS SCORES, OR REPLACE PREVIOUS SCORES (A/\
     \R): ";X$:
     REP=(LEFT$(X$,1)="R"):
     IF NOT REP
       IF LEFT$(X$,1)<>"A" THEN 1070
1080 PRINT "ENTER SCORE POSSIBLE /";MX!(CLMN);:
     INPUT "/: ";MX!(CLMN)
1090 PRINT "ENTER WEIGHT /";WT!(CLMN);:
     INPUT "/: ";WT!(CLMN)
1100 REM ENTER EACH SCORE
1110 NW=0:
     NU=0:
     INPUT "ENTER STUDENT NUMBER: ";NU
1115 IF NU=0 THEN 200
1120 GOSUB 6000:
     IF NOT BAD THEN 1130
1121 FOR I=0 TO 669:
```

```
     IF SN(I)=NU THEN 1130
1122 NEXT I:
     PRINT "NO SUCH STUDENT. ":
     GOTO 1110
1130 IF NOT REP THEN 1200
1140 PRINT "ENTER SCORE /";SA!(CLMN);:
     INPUT "/: ";SA!(CLMN)
1150 GOSUB 6500:
     GOTO 1110
1200 PRINT "CURRENT SCORE =";SA!(CLMN)
1210 INPUT "ENTER ADDITIONAL SCORE: ";X!
1220 SA!(CLMN)=SA!(CLMN)+X!
1230 GOSUB 6500:
     GOTO 1110
2000                          MAINTENANCE OF INDIVIDUAL STUDENT'S SCORES
2010 C9=0:
     NU=0:
     INPUT "ENTER STUDENT NUMBER: ";NU:
     IF NU=0 THEN 200
2020 GOSUB 6000
2025 IF BAD PRINT "NO SUCH STUDENT":
       GOTO 2010
2030 CLS:
     PRINT "STUDENT NUMBER: ";NU
2032 FOR I=0 TO 9:
       PRINT USING "(##) %   % = ###.#";I+1, CN$(I), SA!(I):
     NEXT I:
     PRINT
2040 S=0:
     INPUT "CHANGE WHICH ITEM /<NONE>/: ";S
2050 IF S=0
       IF C9 THEN 2080
       ELSE 2010
2060 INPUT "ENTER SCORE: ";X!
2065 IF X!<>SA!(S-1)THEN SA!(S-1)=X!:
       C9=-1  'C9 = CHANGE MADE FLAG
2070 GOTO 2030
2080 GOSUB 6500:
     GOTO 2010 'STORES NEW DATA IF A CHANGE WAS MADE
3000                                         PRINT REPORT OF SCORES
3010 REM COMPUTE AVERAGES
3020 FOR I=0 TO CU:
       TS!(I)=0:
       VS!(I)=0:
     NEXT I
3030 CO=0:
     FOR L1=1 TO LS:
       GOSUB 5000
3040   IF P0<>P1 GET 1,P1:
         P0=P1
3050   IF CVI(S0$)=0 THEN 3080
3055   CO=CO+1
3060   FOR I=0 TO CU:
         S!=CVS(MID$(SA$,I*4+1,4)):
         TS!(I)=TS!(I)+S!
3070   NEXT I
3080 NEXT L1
3090 WM!=0:
     TA!=0:
     FOR I=0 TO CU:
       AV!(I)=TS!(I)/CO:
       TA!=TA!+AV!(I)*WT!(I):
       WM!=WM!+MX!(I)*WT!(I):
     NEXT I
3100 REM PRINT REPORT AND COMPUTE STANDARD DEVIATIONS
3102 LINE INPUT "SET PAPER AND TYPE <ENTER>: ";X$
3104 LPRINT "STUDENT";:
     FOR I=0 TO CU:
       LPRINT "       ";:
     NEXT I:
     LPRINT " TOTAL"
3106 LPRINT "NUMBER ";:
     FOR I=0 TO CU:
       LPRINT " ";CN$(I);:
     NEXT I:
     LPRINT " SCORE  PERCENTAGE"
3110 FOR L1=1 TO LS:
       GOSUB 5000
3120   IF P0<>P1 GET 1,P1:
         P0=P1
3130   NU=CVI(S0$):
       IF NU=0 THEN 3160
3135   LPRINT USING "#####   ";NU;
3140   CS!=0:
       FOR I=0 TO CU:
         S!=CVS(MID$(SA$,I*4+1,4)):
         CS!=CS!+S!*WT!(I):
         LPRINT USING NF$;S!;:
         VS!(I)=VS!(I)+(S!-AV!(I))*(S!-AV!(I))
3150   NEXT I
3152   VS!=VS!+(CS!-TA!)*(CS!-TA!)
3155   LPRINT USING "###.#     ###.#";CS!,CS!*100/WM!
3160 NEXT L1
3170 LPRINT " ":
     LPRINT "TOTAL   ";:
     FOR I=0 TO CU:
       LPRINT USING NF$;TS!(I);:
     NEXT I:
     LPRINT
3180 LPRINT "AVERAGE ";:
     FOR I=0 TO CU:
       LPRINT USING NF$;AV!(I);:
     NEXT I:
     LPRINT USING "###.#     ###.#";TA!,TA!*100/WM!
3190 LPRINT "STN DEV ";:
     FOR I=0 TO CU:
       LPRINT USING NF$; SQR(VS!(I)/(CO-1));:
     NEXT I:
     LPRINT USING "###.#     ###.#"; SQR(VS!/(CO-1)),SQR(VS!/(CO-1))*100\
     \/WM!
```

```
3200 LPRINT "POSSIBLE";:
     FOR I=0 TO CU:
       LPRINT USING NF$;MX!(I);:
     NEXT I:
     LPRINT USING NF$;WM!
3210 LPRINT "WEIGHT  ";:
     FOR I=0 TO CU:
       LPRINT USING NF$;WT!(I);:
     NEXT I
3220 LPRINT CHR$(138):
     GOTO 200
5000                                              SUB-RECORD ALLOCATION
5010 P1=INT((L1+5)/6)+1 'COMPUTE PHYSICAL RECORD NUMBER
5020 S1=L1-6*P1+11    'COMPUTE POSITIONING WITHIN PHYSICAL RECORD
5030 FIELD 1, (42*S1) AS DUMMY$,2 AS S0$, 40 AS SA$
5040 RETURN
5140 REM S0 - STUDENT NUMBER
5150 REM SA - SCORE AMOUNTS
5990 REM
6000                      RETREIVE RECORD FROM FILE AND FILL VARIABLES
6003 BAD=-1:
     L7=0  'BAD= STUDENT DOES NOT EXIST, L7= FIRST AVAILABLE SUB RECORD\
     \
6050 FOR L1=1 TO LS
6060   GOSUB 5000
6065   IF LS=0 RETURN
6070   IF P0<>P1 GET 1,P1:
         P0=P1     'P0= CURRENT RECORD, P1= DESIRED RECORD
6075   S0=CVI(S0$)
6080   IF NU=S0 THEN 6110    'FOUND STUDENT ENTRY
6085   IF S0=0
         IF L7=0 THEN L7=L1
6090 NEXT L1
6100 RETURN
6110 BAD=0
6120 FOR I=0 TO 9:
       SA!(I)=CVS(MID$(SA$,I*4+1,4)):
     NEXT I
6150 RETURN
6500                                              STORE DATA INTO FILE
6510 GOSUB 5000
6520 IF P0<>P1 GET 1,P1:
       P0=P1
6530 LSET S0$=MKI$(NU)
7000 FOR I=0 TO 9:
       LSET SA$=LEFT$(SA$,I*4)+MKS$(SA!(I)):
     NEXT I
7050 PUT 1,P1
7060 IF L1>LS THEN LS=L1
7070 RETURN
8000                                              SCORE FILE INITIALIZE
8005 CU=-1:
     LS=0
8010 FOR I=0 TO 9:
       CN$(I)="     ":
       MX!(I)=0:
       WT!(I)=0:
     NEXT I
8020                                              STORE HEADER RECORD
8030 GOSUB 8200
8040 GET 1,1:
     P0=1:
     LSET LS$=MKI$(LS):
     LSET CU$=MKI$(CU)
8050 FOR I=0 TO 9
8060   LSET HN$=LEFT$(HN$,I*5)+CN$(I):
       LSET HM$=LEFT$(HM$,I*4)+MKS$(MX!(I)):
       LSET HW$=LEFT$(HW$,I*4)+MKS$(WT!(I))
8070 NEXT I
8080 PUT 1,1:
     RETURN
8100                                              LOAD HEADER INFORMATION
8110 GOSUB 8200:
     GET 1,1:
     P0=1:
     LS=CVI(LS$):
     CU=CVI(CU$)
8120 FOR I=0 TO 9:
       CN$(I)=MID$(HN$,I*5+1,5):
       MX!(I)=CVS(MID$(HM$,I*4+1,4)):
       WT!(I)=CVS(MID$(HW$,I*4+1,4)):
     NEXT I
8130 RETURN
8200 FIELD 1, 2 AS LS$, 2 AS CU$, 50 AS HN$, 40 AS HM$, 40 AS HW$:
     RETURN
8500                               LOAD PARAMETERS FROM 'PARAM/DTA' FILE
8510 OPEN "R",1,"PARAM/DTA"
8520 FIELD 1,2 AS PA$, 2 AS DV$
8530 GET 1,1
8540 DA=CVI(PA$)  'DEFAULT AREA CODE
8550 DV$=DV$         'DRIVE NUMBER APPENDAGE (THIS STATEMENT SEEMS TO BE\
     \ REDUNDANT BUT IT REDEFINES DV$ TO BE A REGULAR STRING VARIABLE  \
     \(NON-FIELDED))
8560 CLOSE 1
8570 RETURN
8700                                              LOAD STUDENT NUMBERS TABLE
8710 OPEN "R",1,"STUDENTS/DTA"+DV$:
     FIELD 1, 2 AS C$:
     GET 1,1:
     LS=CVI(C$)
8720 FOR L1=1 TO LS:
       FIELD 1, (128-126*(L1 AND 1)) AS DUMMY$, 2 AS M0$:
       IF L1 AND 1 GET 1,(L1+1)/2
8730   SN(L1)=CVI(M0$):
     NEXT L1:
     CLOSE 1:
     RETURN
9000 GOSUB 8020:
     CLOSE
9010 RUN "GRADING"
```

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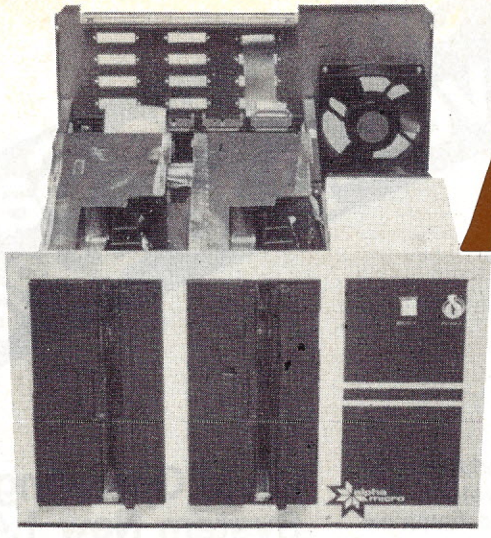
System of the Month

Alpha Micro



Courtesy of Alpha Micro

By Tom Fox, Systems Editor

Alpha Micro Systems computers are a different breed than the usual run of personal or small business computers. To begin with, the 16-bit machine is more expensive than its 8-bit cousins, although it shares the same S-100 bus with most of them. It can be purchased with such a wide variety of peripheral devices that its price and capabilities can climb into the minicomputer region if full advantage is taken of them.

The system has a built-in capability for multiple simultaneous users, which by itself sets it apart from most of the small business computers. Alpha Micro's supporters will tell you that it is a system that can be purchased initially for only a little more than a capable 8-bit computer, and can grow with your needs by simply adding hardware as it is needed.

HARDWARE

Of all those devices which would seem to be strange companions to the S-100 bus, the AM-100 CPU must be near the head of the list. The S-100 was originally intended to be used with 8-bit microprocessors such as the 8080 and Z-80. All of the memory boards available for this bus are likewise limited to 8-bit words as the logical addressable element. In order to utilize the available 8-bit memory boards, the AM-100 has to split up read and write transfers from its 16-bit microprocessor into two "half-word" movements.

Since memory accesses occur at the relatively slow rate (these days) of 500 nanoseconds per transfer, you would expect the AM-100 to be a slow computer. That it definitely is not, and the credit goes to the host of features which are an integral part of the Western Digital WD16 microprocessor — the heart of the Alpha Micro machine.

It has, for example, built-in floating point arithmetic, freeing the system software from that time-consuming task. One of the benefits is an 11-digit precision for all numbers. A rich repertoire of over 100 directly executable instructions, most with four or more separate addressing modes, tends to reduce the number of machine cycles needed. The WD16 is implemented in five separate chips, two of which are the actual "works" of the CPU and the remaining three read-only memories (ROMs) which contain the microinstructions which give the processor its personality.

The AM-210 Floppy Disk Controller has two major functions: it contains the controller for any floppy disk drives connected to the system, and it is the home for a ROM containing the bootstrap program needed to being up the AM-100 from a cold start. The AM-210 will control up to four separate floppy disk drives, either the five- or eight-inch size, and either single or double density or single or double sided recording format.

If you purchase an AM-300 Serial Interface with your Alpha Micro system, you will be prepared for a lot of future expansion: six separate asynchronous terminals and/or printers operating simultaneously. The AM-300 contains six of the Western Digital ASTRO Universal Synchronous/Asynchronous Receiver-Transmitters (USARTs).

Featured by the AM-300 is a multi-level interrupt capability, which relieves the AM-100 from the task of continuously polling each of the connected terminals to see if a character has been input from the keyboard.

One of Alpha Micro's newest products, the AM-310 Communications Controller, manages four simultaneous channels of synchronous or asynchronous data communication with the same selection of baud rates as the AM-300. This board is one of the several in Alpha Micro's catalog that is implemented with an on-board Z-80 microprocessor and program supplied in ROM. With appropriate software enhancements, it is intended that the AM-310 handle a variety of data communication protocols, including BI-SYNCH and SDLC.

More than just an interface board, the AM-400 Hard Disk Subsystem includes from one to four Calcomp Trident hard disk drives, each of which can be configured to hold from 25 to 300 megabytes of data. This is the giant of the family, and is so expensive that it is far less popular than, say, the smaller AM-500.

The AM-500 Hard Disk Subsystem is by far the most-often ordered disk with an Alpha Micro system. It has about the right capacity for most small businesses using the Alpha-Accounting software package: ten megabytes, including a five-megabyte removable cartridge. The disk drive itself is the Control Data Hawk, many thousands of which have been installed over the past years.

The AM-600 Magnetic Tape Interface board provides the unique capability for connecting an S-100 bus to a variety of computer industry standard magnetic tape drives. The AM-600 will support up to eight one-half inch tape drives, either the 7- or 9-track variety, with bit densities up to 1600 bits per inch and speeds to 45 inches per second. DMA and interrupt capability are provided, so that large block sizes (to 65 kilobytes) are possible.

MULTI-USER OPERATION

A good part of the reason for Alpha Micro's unique position in the small computer marketplace is their product's

ability to simultaneously run several programs at the same time. This capability is variously called timesharing, multi-tasking or multi-user.

Even if the system has only one terminal, the multi-tasking capability of the machine is needed. Borrowing from large computer concepts, Alpha Micro has built in the capability for dedicating a "phantom" job — one with no actual terminal attached to it — to the job of sending text to the system's printer. This job is the Spooler, and it has the capability for accepting a request from any other terminal to print out one or more disk data files.

If several users have made requests, the Spooler queues them up on a first-come, first-served basis. The benefit is that once a terminal has requested that one or a list of files be printed, it is free to go on and perform other computing actions.

Since the printer is probably the slowest part of the whole computer complex (except for operator's fingers on the keyboards), it's a great timesaver. The Spooler implemented on this system has several unusual capabilities, such as the ability to send output to several printers simultaneously, and to show the name of the file being printed in big block letters on the first page of printout.

SOFTWARE

The quantity and diversity of the software supplied with the system are what really set it apart. With the AM-100 CPU comes a disk with more than 277 separate programs, subroutines, and data files, ranging from the AlphaBASIC package (totaling over 32,000 bytes) to a midget 160-byte program with the equally diminutive name of "U".

Languages

AlphaBASIC, AlphaPASCAL, AlphaLISP, and the WD16 MACRO assembler are the major languages supplied, with rumors of an imminent FORTRAN being carefully cultivated. LISP is an interpretive language, whereas the others are compilers of one sort or another.

The major applications language is AlphaBASIC, which is implemented in a rather unusual function. Programs can be written in two ways: by use of one of the text editor programs, then compiled separately, or while "in" the BASIC language itself. The latter method acts most like the language's treatment in other systems.

The difference comes when you type RUN. The system takes that command as its cue to also load into memory the 11,064-byte RUN.PRG program, which is needed to compile the source program just entered. The result is a run-time module of machine executable object code which is from 20 to 80 percent of the size of the original program. Once this process has finished (about ten seconds for 8,000 bytes of source code), the program begins to run in the normal manner.

The alternative method for entering BASIC programs is to build the source code with one of the text editing programs, EDIT or VUE. Of course, BASIC syntax errors are not detected by these editors as you enter each line. Once the source of a BASIC program is completed, another program called COMPIL.PRG is invoked, which creates a runnable object version nearly identical to the one generated while "in" BASIC. Following that process, the Monitor command RUN (program name) will cause the program to execute.

Pascal is forecast by many to be the universal applications language of the future, and Alpha Micro was one of the first to provide it. AlphaPASCAL was developed in cooperation with the University of California at San Diego, so it contains the extensions to the original implementation of the language (string handling, etc.) associated with UCSD Pascal.

Subroutines

Auxiliary programs and subroutines that can be called from a running AlphaBASIC program make up a major portion of the software supplied with the computer. ISAM (Indexed-Sequential Access Method) is there, which provides a sophisticated method for quickly finding a particular random file record. (Random files, incidentally, can be any chosen length up to 512 characters long.)

Other subroutines include the ability to send data files to the system printer spooler and two separate methods for policing simultaneous access to data files by different system users. This latter capability solves a problem that does not exist on simpler, single-terminal computers.

Editors

The original text editor supplied with the Alpha Micro system is a variant of the venerable TECO, introduced to a generation of users through Digital Equipment computers. Although EDIT is still supplied, it was instantly replaced by a text handler called AlphaVUE as "the" system editor when released in January. VUE is a truly amazing example of a user-oriented interactive program. It can be used to enter programs in nearly any language, and has special capabilities for reducing the workload of the programmer while doing so.

Although not in the strictest sense an editor, the TXTFMT (for Text Formatting) program is Alpha Micro's answer to the "other half" of the word processing problem. Features are included to automatically divide a document into pages and supply page numbers and headings, if desired. The program will also automatically build a Table of Contents and an Index, which is a listing of the page numbers containing each occurrence of selected words.

Commands

Many of the programs supplied with the Alpha Micro are really commands that can be entered by the user while in the Monitor mode (indicated on the CRT screen or teleprinter as a "."). Simply typing a word such as DIR causes the system to load a program by that name from the disk into memory and begin executing it. DIR causes a directory of disk file names to be displayed on the terminal.

Other commands (programs) which act on disk files are COPY, RENAME, ERASE, DIRSEQ (to alphabetize the file directory), TYPE (to display the contents of a file on the user's terminal) and PRINT (to send the file to the printer spooler).

Drivers

Another important category of software is the terminal and device drivers, which are the means by which various hardware devices such as terminals and disk drives are interfaced to the AM-100 CPU. Drivers are small but tricky programs that must be written in the WD16 machine language. Since most users do not have the capability for doing this, it is fortunate that Alpha Micro provides drivers for a range of devices: 15 or so different brands of terminals and printers and an equal number of disk devices — from simple mini-floppies through multiple 300-megabyte hard disk drives.

It is noteworthy that Alpha Micro supplies the source listings to the driver programs (as well as a very few others), which savvy users can modify to fit hardware devices that are missing from the list of those "officially" supported by the computer manufacturer.

Alpha Micro exposes its attitude towards purchasers of their machines with a policy which should be far more widespread than it is: essentially free distribution of software updates and enhancements. For $100 per year, any owner will receive a package every three months containing all of the documentation which is new, as well as a disk with any updated or new programs.

Software of an entirely different sort is the AlphaAccounting business applications package. This is an extensive set of AlphaBASIC programs and assembly-language subroutines that have been largely translated from a mature accounting package originally written in DIBOL, a COBOL-like language.

Continued on Page 99

The Pascal Notebook Chapter 4

By Henry Davis, Associate Editor

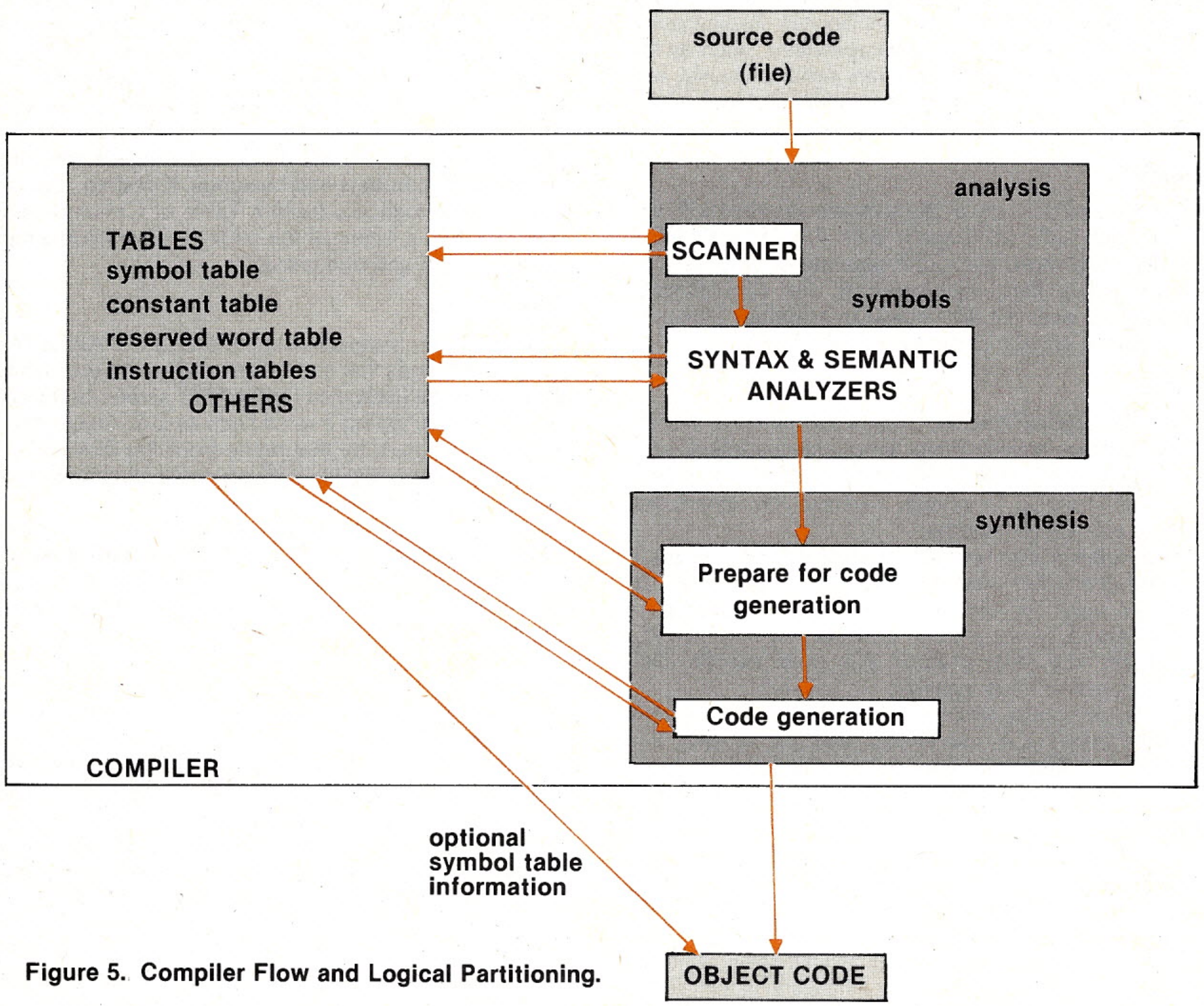


Figure 5. Compiler Flow and Logical Partitioning.

Road Map — Chapter 4

This chapter begins the actual presentation of the Pascal P-compiler. As a historical footnote, the so-called "P-compilers", and indeed the great majority of Pascal compilers, have been based on a series of compilers produced at ETH, Zurich. Examples of these related compilers include the University of California at San Diego's Pascal compiler, the CDC-6000 Pascal compiler and the P-compiler described in this series.

The ETH compilers have been written in Pascal using exactly the subset of the language that it processes. The effort and purpose of the programming task was to produce a portable compiler — hence the name P-compiler. Initially, the decision was to generate object code for a hypothetical stack computer called the SC machine (see Figure 5 for the process flow involved in compiling a program).

Later references to the SC machine by UCSD and others changed the name to the P-machine and termed the object code P-code. Regardless of terminology, the purpose behind this approach is to produce an easily transportable and maintainable compiler. Towards this end, the P-compiler was im-

plemented using step-wise program refinement. The sequence followed was:

step 1: syntax analysis
step 2: syntax analysis with some error recovery
step 3: generate compiler tables
step 4: process errors not covered in step 2
step 5: assign addresses to variables
step 6: code generation

The most important fact in this sequence of refinements is that the first four steps are independent of the target machine. To obtain a native code compiler for Pascal, steps five and six are repeated for each new machine — say a 9900, 6800, 8080 or Z80. In fact, step six could be expanded to include various methods of optimization.

How does all this help you get Pascal for your system? Because of the availability of general Pascal compilers, many companies offer complete Pascal packages that will run on your system. You have the option of implementing your own compiler or modifying one that you purchase. In any case, a good understanding of the workings of a Pascal compiler will greatly increase your understanding of not only the software package, but the Pascal language as well. Additionally, you are likely to pick up some new programming techniques and methods which will make the art of programming more enjoyable.

THE COMPILER

The language processed by the Pascal P-compiler is the standard Pascal, as defined earlier, and in Jensen and Wirth, with only two omissions and three changes.

The omissions are:

1. procedures/functions as parameters
2. all features associated with packing

The changes are:

1. GOTOs may not lead out of procedure/function bodies.
2. Only files of type text are allowed.
3. The standard procedure "Dispose" is replaced by two procedures: "Mark" and "Release".

Any program as large as a compiler is bound to have a significant number of constants and other data structures. For the most part, the meaning and use of the data structures can be put off until they are used. However, some discussion of the constants will provide a taste of the programming style. At least a cursory reading of the variable declaration area should be made at this point.

CHARSIZE,PTRSIZE,INTSIZE,BOOLSIZE,REALSIZE,SETSIZE:

These constants define the number of storage units required to store values of characters, pointers, integers, booleans, reals and sets. Allocation of memory is based on these constants. The topic of storage allocation is treated later.

INTAL,REALAL,CHARAL,BOOLAL,SETAL,PTRAL:
Variables of the corresponding types are assigned addresses which are a multiple of these alignment constants.

STACKELSIZE:
The minimum size for a value on the expansion stack.

STACKAL:
The alignment constant for a value on the expression stack.

STRGLGTH:
The maximum length of a string.

INTBITS:
The number of bits used to represent an integer without the sign.

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SETHIGH, SETLOW:
Maximum and minimum ordinal values for the element of a set.

ORDMAXCHAR, ORDMINCHAR:
The maximum and minimum ordinal values of the character set.

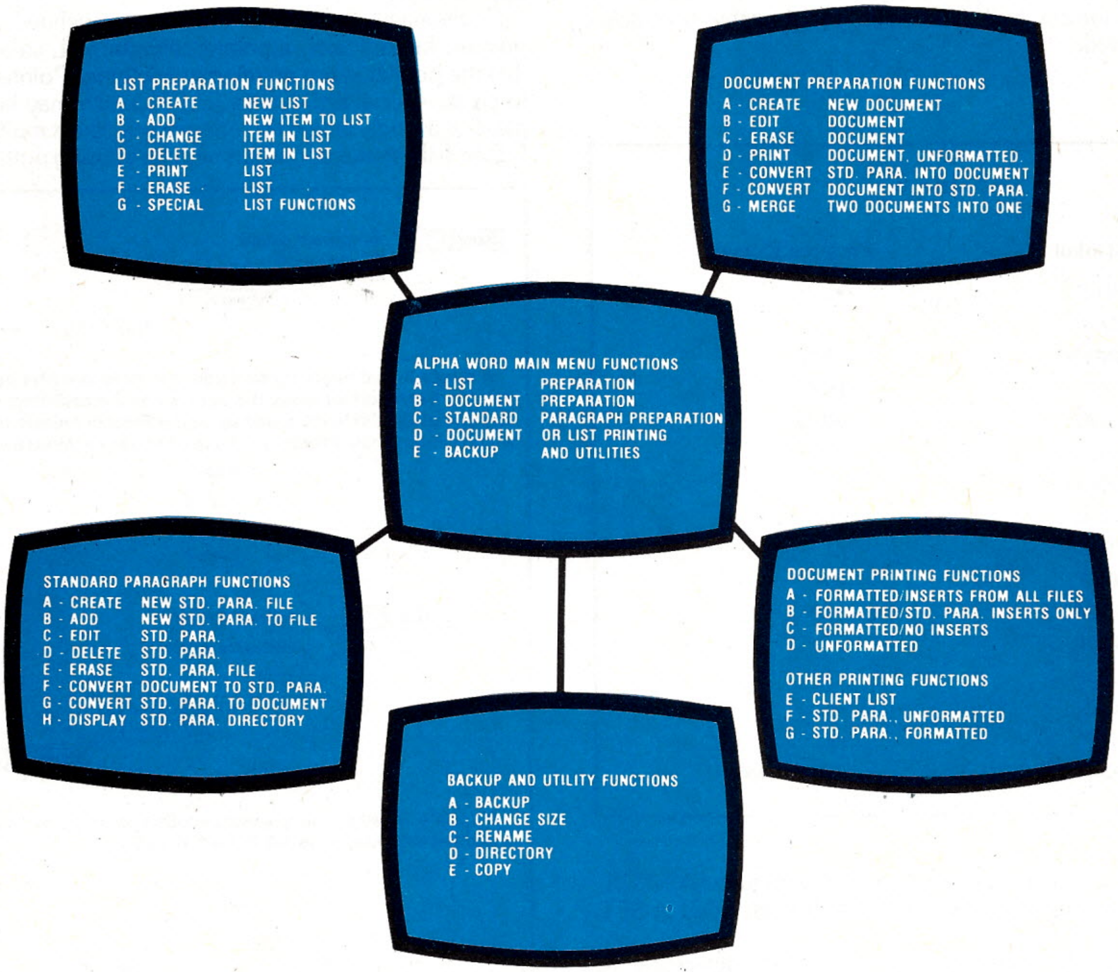
Due to the fact that these constants are assigned names, producing a P-compiler for a new computer is relatively easy. Accommodating different word sizes is really a question of reconfiguring the storage allocation and code genera-

Table 5.

NAME	PROGRAM ELEMENT
IDENT	identifier
INTCONST	integer constant
REALCONST	real constant
STRINGCONST	string constant
NOTSY	not symbol
MULOP	multiplication operator
ADDOP	addition (includes subtraction)
RELOP	relational operator
LPARENT	left parenthesis
RPARENT	right parenthesis
LBRACK	left bracket
RBRACK	right bracket
COMMA	comma (separator)
SEMICOLON	semicolon (statement terminator)
PERIOD	period
ARROW	up arrow (replaced by at sign @)
COLON	colon
BECOMES	assignment— 2-character symbol :=
LABELSY	LABEL
CONSTSY	CONST
TYPESY	TYPE
VARSY	VAR
FUNCSY	FUNCTION
PROGSY	PROGRAM
PROCSY	PROCEDURE
SETSY	SET
PACKEDSY	PACKED
ARRAYSY	ARRAY
RECORDSY	RECORD
FILESY	FILE
FORWARDSY	FORWARD
BEGINSY	BEGIN
IFSY	IF
CASESY	CASE
REPEATSY	REPEAT
WHILESY	WHILE
FORSY	FOR
WITHSY	WITH
GOTOSY	GOTO
ENDSY	END
ELSESY	ELSE
UNTILSY	UNTIL
OFSY	OF
DOSY	DO
TOSY	TO
DOWNTOSY	DOWNTO
THENSY	THEN
OTHERSY	

ALPHA WORD™

ALPHA MICRO MENU DRIVEN WORD PROCESSOR



ALPHA WORD is a complete menu driven word processing system written for the Alpha Micro AM-100 computer.

The Document and Standard Paragraph processors have the main features of Alpha Micro's VUE text processor, including line insert and delete, word insert and delete, page skipping, global search and replace, automatic linefeed at the end of the line, and block move, copy and delete. Your text is interactively stored on disk to ensure system reliability.

The List processor design is a general linked list, with user defined data items and data item keys.

The users manual for ALPHA WORD is written in such a manner that your secretary can easily learn the system in a few hours. This is possible through the use of extensive examples and an easy to read style.

Enhancements appearing in future revisions of ALPHA WORD will be made available to registered users for $30 on floppy disk. Future versions will include (1) Spelling error correction and detection, (2) Automatic index and table of contents generation, (3) Half justification and automatic hyphenations. (4) List search display similar to IBM System 6.

ALPHA WORD software is shipped on an 8 inch floppy disk in standard or AMS format, or on a hard disk for an additional $100. Demonstration disks, including users manual, are available for $35 or users manual separately for $15 each.

ALPHA WORD software has been reduced by popular demand to **$600**, with quantity discounts to dealers.

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tion portions of the compiler via these constants. Additionally, the compiler program is easier to read and understand since there are no "magical" numbers embedded in the code.

Several types are declared for use in all phases of the compiler. Table 5 details the members of the type SYMBOL. These symbols are used in scanning and parsing the source code, and are variously referred to as "keywords," "reserved words," and of course, as "symbols." Some people take great care to differentiate between these various phrases. What is important is that these multicharacter names are considered as basic entities by the compiler and compiler writer.

The type OPERATOR includes all operators, both arithmetic and logical, in the Pascal language. Table 6 identifies each operator.

Table 6.

Symbol	Program Element
MUL	•
RDIV	/
ANDOP	AND
IDIV	DIV
IMOD	MOD
PLUS	+
MINUS	−
OROP	OR
LTOP	<
LEOP	<=
GEOP	=>
GTOP	>
NEOP	<>
EQOP	=
INOP	IN
NOOP	no operation

SETOFSYS defines a set of symbols with type SYMBOL. That is, each of the symbols in Table 5 is included in SETOFSYS.

During certain operations, it is desirable to determine the type of character which has been found. CHTP (character type) may be a letter, number, special or illegal. You may skip over the remainder of the declarations until you reach the section of variable declarations. For the most part these variables are fully explained in the comments. It is not necessary at this point to read, in depth, beyond the "Bookkeeping of declaration levels" comment.

The program schema, or form, used in the compiler is:

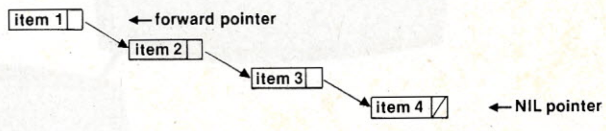
```
BEGIN
        INITIALIZATION
        EXECUTION
END
```

Initialization is split into two parts. First, the scalars, sets and tables are initialized. Then the areas of memory containing the symbol table is set up along with standard defined procedures and types. Following the listing L2 (to be published next month), three procedure calls are made immediately: INITSCALARS, INITSETS, and INITTABLES. These calls initialize the appropriate data structures. Next the scalars LEVEL and TOP are both assigned the value 0.

It may be of some help to verbalize each statement as you read it. Procedures are usually named so that reading the procedure name makes that procedure's function obvious. For example, it should be clear that INITSCALARS initializes scalars upon being encountered in the source text. To verbalize the assignment statement: LEVEL :-0; say: level receives zero or level becomes zero.

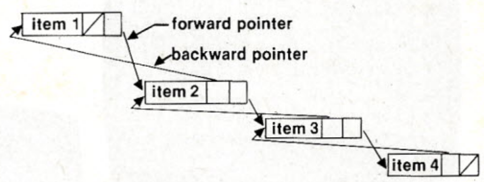
The data structure DISPLAY will be covered later in this series. However, as an introduction, it is important to recall from Chapter 3 that the WITH DISPLAY [0] DO statement is a shorthand indicator for the next Begin-End block; each of the variables FNAME, FLABEL and OCCUR are selectors of DISPLAY [0].

Additionally, the symbol NIL is a predefined value for a pointer. In particular, a pointer with the NIL value indicates that the pointer is not pointing to anything. Pointers are used to create specialized data structures which may be very simple, like a singly linked list, or complex, like a multilinked list. Figure 6 illustrates some data structures using pointers.

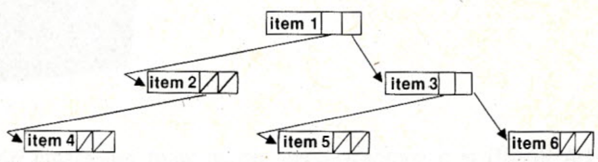


A singly linked list is formed from a data record (the items) and a pointer. Each pointer gives the address of the next item in the list. The end of the list is indicated by a nil pointer (a pointer with a value which cannot occur otherwise). Such a list has an implied ordering of:

item 1
item 2
item 3
item 4



A double linked list simply adds another set of pointers to a single linked list allowing traversal in both directions.



A binary tree, so-called because of its branching structure, can be formed by using two pointers. Each item in this structure is called a node. The node corresponding to item 1 is termed the root of the tree. Those nodes containing only nil pointers are termed leaves. The tree structure will be used later in this compiler for handling some of Pascal's structures.

Figure 6.

Execution of the compiler begins by fetching (obtaining) the first symbol by invoking the INSYMBOL procedure. Next, a call to the PROGRAMME procedure begins the process of compilation. Referring to the syntax diagrams of Chapter 3, you will see that only certain symbols are allowed at the beginning of a Pascal program.□

NEXT MONTH

Chapter 5 begins with tracing initialization, detailing some of the terms used in determining the parameter passed to the PROGRAMME routine.

My TRS-80 Likes Me
When I Teach Kids How to Use It
Part 2

By Bob Albrecht

This series began as an outline for parents and teachers on how to help kids learn to use, program and enjoy computers. These ideas are best used when a kid asks, "How does the computer do that?," or "How can I make the computer do what I want it to do?," or "Can the computer tell me (whatever)?," or . . .

So, the kids have played Hurkle, Hangman, Guess My Number, Taxman, Star Trek and countless other games. Now they want to know more; they want to write game-playing programs; they want to put interesting visual patterns on the screen; they want to control the computer.

PATTERNS

What we will do this time is put patterns on the screen, using tiny rectangles of light. And, we will do some "computer art," using the familiar RND function and a new BASIC statement called SET.

SET turns on a tiny rectangle of light somewhere on the screen. We must tell the TRS-80 where to turn on the tiny rectangle of light.

```
          SET (64,24)

   This far        This far
    OVER            DOWN
```

Think of it like this: SET (OVER,DOWN). OVER can be a whole number, 0 to 127. DOWN can be a whole number, 0 to 47.

Try these to get the hang of things.

Press CLEAR, then press ENTER
Type SET (0,0) and press ENTER
Type SET (127,0) and press ENTER
Type SET (0,47) and press ENTER
Type SET (127,47) and press ENTER

Now for each of the following, guess where the rectangle will appear before you press ENTER. Were you close?

Type SET (0,24) and press ENTER
Type SET (127,24) and press ENTER
Type SET (64,0) and press ENTER
Type SET (64,47) and press ENTER
Type SET (64,24) and press ENTER
Type SET (32,12) and press ENTER

STARFALL

Now, pretend that the screen is the sky. Also, pretend that each tiny rectangle of light is a star appearing in the night sky. Make it happen by storing and running this program.

```
NEW
100 CLS
110 OVER = RND (127)
120 DOWN = RND (47)
130 SET (OVER,DOWN)
140 GOTO 110
```

When you RUN this program, the sky will begin filling with stars. Try to find constellations, shapes and patterns as stars turn on. Too fast? Add a time delay.

```
133 T = 100
135 FOR Z = 1 TO T
137 NEXT Z
```

Or, here is a trick you can use to stop the action momentarily while you stargaze, then continue letting more stars come out. Add these lines to the program.

```
140 IF INKEY$ = "" THEN 110
```

This line 140 replaces the old line 140.

```
150 IF INKEY$ = "" THEN 150
160 GOTO 110
```

After adding the above lines (140, 150, 160) to the original program RUN the modified program. To stop it, press any key; then, to continue, press any key. Now you can stop time! Or restart it! Happy stargazing.

WALKABOUT

Suppose you start near the center of the screen (OVER = 64, DOWN = 24) and walk (stagger?) at random. Up? Down? Left? Right? Try this program.

```
NEW
100 CLS
110 OVER = 64
120 DOWN = 24
130 SET (OVER,DOWN)
140 A = RND (3) — 2
150 B = RND (3) — 2
160 OVER = OVER + A
170 DOWN = DOWN + B
180 GOTO 130
```

This program will start near the center of the screen and meander. Eventually, it will (probably) stop with an error message.

?FC ERROR IN 130

That happens because it tried to wander off the screen. OVER became less than 0 or more than 127 or DOWN became less than 0 or more than 47. Let's fix that little bug by adding these lines to our program.

```
163 IF OVER<0 THEN OVER = OVER + 1
167 IF OVER>127 THEN OVER = OVER — 1
173 IF DOWN<0 THEN DOWN = DOWN + 1
177 IF DOWN>47 THEN DOWN = DOWN — 1
```

These additions to the program will sometimes seem to make the screen image "bounce along" against the edge of the screen. Try it. As the pattern develops, what shapes do you see? A castle? A dragon? A flower?

Wouldn't it be nice to be able to stop the computer and look at the pattern on the screen? Or photograph it? Easy, just add the following statements.

```
180 IF INKEY$ = "" THEN 130
190 IF INKEY$ = "" THEN 190 ELSE 130
```

Now, having added the above lines 180 and 190, RUN the program. To stop it, press any key (except BREAK!). Gaze upon the pattern on the screen. Then press any key (except BREAK) and the pattern will continue growing.☐

This series originally appeared in Calculators and Computers *magazine. The author may be contacted at P.O. Box 310, Menlo Park, CA 94025.*

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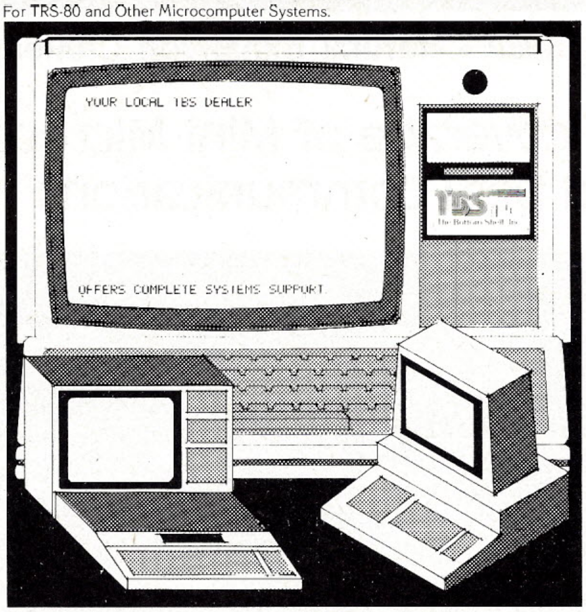

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Level II Index
Random Ramblings

A camera is useless without film; a typewriter is useless without paper; a computer system is useless without the necessary support to make it completely operational. TBS is leading the way in systems support, and we are proud to announce a new concept for the microcomputer industry - **FULL SYSTEMS SUPPORT**. Mainframe and minicomputer industries have been following this concept for years. However, until now it has not been available for microcomputer systems. TBS Full Systems Support is aimed at helping you, the computer owner, acquire the necessary support items quickly and inexpensively through a network of affiliate dealers nationwide.

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A SCHOOL COMPUTER
Continued from Page 64

Once the groundwork of BASIC was laid, most of the emphasis was on business programs like payrolls, inventories, depreciation schedules, etc. Many left the last session with hopes of having more opportunities. It turned out to be a great way to help bridge part of the gap between the schools and the community.

The greatest obstacle to getting the best use from the system is probably time. It is unbelievable how much time it takes to maintain a system and to develop good software for specific needs.

A second obstacle or problem which should be resolved before the delivery of the computer is what is it going to be used for and by whom? I would definitely suggest that one individual be delegated as a "system manager" and be in charge of maintenance, supplies and, if available, I.D. and passwords. It becomes very easy for a teacher to send a few students into the computer room unsupervised if their work is done or if a test is being discussed which the students missed. What an opportunity for a teacher to become popular by signing on for the students with privileged I.D. so the students can run "anything."

From personal experience, I would also highly recommend limiting entertainment programs to before or after school hours. The computer has a lot of potential for education, but the device was not purchased by the district to entertain the students.

A third area which needs attention before computer delivery is a method of cataloging all programs which provides the "name" of the program, what input is required, and what output can be expected. At the same time, make some provisions for duplication or "back-up" of any programs worth saving. We have prepared special disks for each subject area as duplicates as well as a listing and sample run of each program.

One last area of consideration is the need for repair and maintenance. Once again we have been fortunate in that our district has purchased a service contract with DEC and they have been very responsive to our needs. Downtime can be irritating if you are in the middle of some integrated work between class and computer. Make provisions in advance as to where to get it repaired and how long it will take.☐

ALPHA MICRO SYSTEM
Continued from Page 87

Included is an integrated set of programs for Accounts Receivable, Accounts Payable, Payroll, General Ledger, and Order Entry/Inventory Control. These programs are so general in nature that there is probably no single business which would want all the features of all programs simultaneously.

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Depending upon your experience, the Alpha Micro system can be either more or less difficult to understand than a more ordinary small business or hobby computer. If you come from a background of large computer installations where concepts of user priority, background jobs and multiple peripheral devices are familiar, you will be right at home with this machine. If, on the other hand, you have managed to avoid until now the world of computers altogether, you will find this computer more confusing than most.

In its flexibility, however, lies Alpha Micro's great appeal. Expansion to larger sizes and more capabilities (at a cost, certainly) is far less bounded than what is usual in the small computer category. Even if you have no grandiose expansion plans, you may find that the rewards of having a system in this class working for you far outweighs the pain of learning how to live with it.☐

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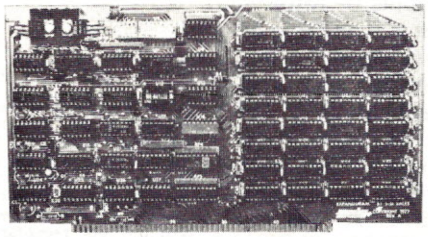

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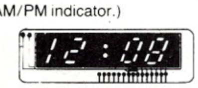

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By Walter F. Stephens
Assistant Chief Instructor
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TABLE OF CONTENTS

Since we have investigated the microprocessor as a basic component, and compared certain facets of various memories, isn't it about time we leap into the main subject of microcomputers? Not quite. Since the real world is analog by nature and our major computing tools today are digital, we must first examine system processes that will allow analog information to be changed into digital information and, conversely, digital into analog.

This month's tutorial covers analog to digital converters (ADC), digital to analog converters (DAC) and concludes with a general discussion of encoders and decoders.

DATA

Analog data is represented in a continuous form in Figure 1a. Digital data is represented in a discontinuous form in Figure 1b. Voltage/current information in both analog and digital form are illustrated in Figure 123. (Note: Figure 123b is not the digital representation of Figure 123a.) Notice that in both graphs voltage or current is plotted against time.

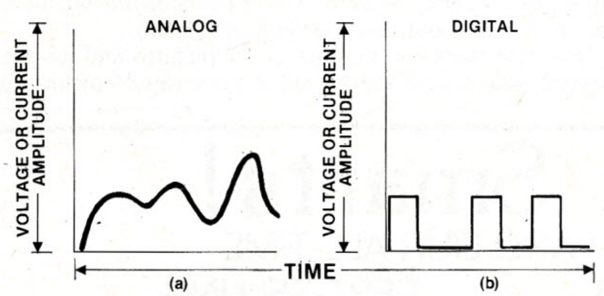


Figure 123.

In Figure 123a this amplitude varies in an uninterrupted manner (continuity), and in Figure 123b the voltage or current amplitude varies in an interrupted sequence (discontinuity).

Analog Data

A few examples of analog data representation are:

1. temperature
2. light
3. pressure
4. rotation
5. sound
6. velocity

Generally in the case of heat, light, sound and mechanics, these energies have to be first transformed into analog currents or voltages by a sensor (transducer) then processed as analog information. If these facets of our physical world are to be processed digitally, then their analog representation has to be converted into digital representation by an analog to digital converter (ADC).

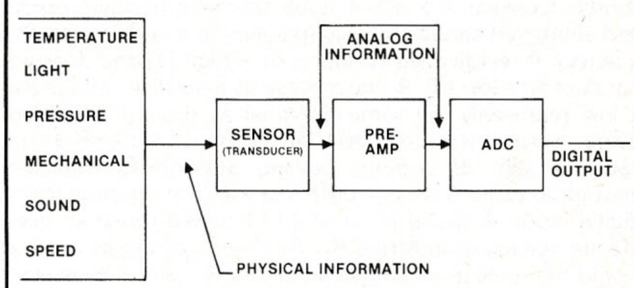


Figure 124.

Digital Data

In contrast to analog figuration, digital representation of quantity and measurement is in discrete steps (pulses). This discrete step concept in combination with the implementation of the binary numbering system and Boolean algebra is what led to the development of the digital computer. Our analog overview gives us somewhat of an idea about what is fed into the digital computer.

Now once the computer (or controller) has processed this information it may either store this data or feed it back to the outside world through peripheral devices. In many cases these peripherals are analog machines or components such as printers, plotters (graph and pictorial), control actuators and metering devices whose inputs require data in analog form. Due to current technological advances, there are, however, certain peripheral devices that operate directly from digital information and do not require a converter.

Our tutorial shall commence with the subject of digital to analog converters, in order to build a foundation for A/D conversion. As we shall see later, the A/D converter utilizes as part of its structure a D/A converter.

The intent of our discussion is to acquaint ourselves with the aspects of process conversion from a general viewpoint, not an in-depth study. The conversion field is a rather complex one and among those companies specializing in these requirements are Analog Devices, Norwood, Massachusetts and Burr Brown, Tucson, Arizona.

DIGITAL TO ANALOG CONVERTERS (DAC)

From a point of simplicity, there are two basic approaches from which to obtain an equivalent analog output from a digital source. In both cases, a network of resistors is involved, digital bits (data) are fed into the network and the output is an analog summation (in steps). Figure 125 illustrates the two resistive networks.

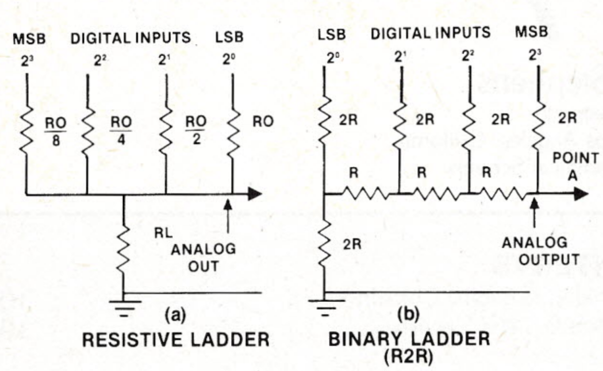


Figure 125.

As we look at the illustration, it is apparent that we have a simple Ohm's Law involvement. Our concept of current here will be electron flow from ground to a more positive source. Consider the digital inputs the more positive source, and submitted simultaneously (parallel) at a certain rate (frequency). A resistive leg conducts on a high (1) and does not conduct on a low (0). A one represents a positive voltage and a low represents the same potential as ground. In Figure 125a, a digital input of 1001 leg MSB and leg LSB would cause a sum of currents flowing through R_L sufficient enough to cause a voltage drop that was in proportion to the digital input. A digital input of 1111 would cause an even greater voltage drop across R_L. As our digital inputs vary, so would the voltage vary in steps across R_L, either increasing or decreasing.

The same action takes place in the binary ladder, Figure 125b. Notice that there are five different values of resistance requires for the resistive ladder whereas with the binary ladder only two are required.

In addition, the R2R network favored as the input impedance of the binary ladder appears more constant to each digital source.

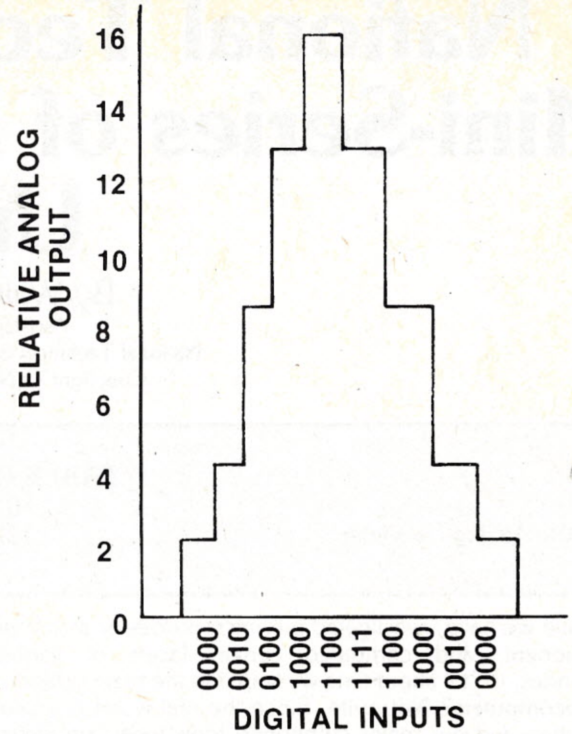


Figure 126. Analog output versus digital input.

Figure 126 illustrates relative analog output from either circuit. This is a step voltage version and if the average were drawn from step point to step point, a smoother rendition would result. From an analog viewpoint we may consider the moving picture (motion picture), where motion is captured in discrete steps (the number of steps dependent on whether sound accompaniment is required).

Let's say each second of motion is captured on film by the camera at the rate of 24 still pictures (frames) per second. If we viewed these same 24 discrete pictures individually, we would see each frame shows a slight displacement of motion (by 1/24 of a second), in steps. The conversion analogy here is continuous (analog)-to-discontinuous (digital).

Now take the same number of still pictures and run them through a device (film projector) at a rate say 24 pictures per

second. We have the illusion of motion. Here the analogy is conversion of discontinuity (digital) into continuity (analog).

TERMS — D/A CONVERTER

RESOLUTION: A measure of the smallest possible increment of change in the analog output that follows a change in the digital input.

ACCURACY: A ratio of the actual analog output voltage to the theoretical analog output voltage.

SETTLING TIME: Time required following a digital input change for the output of the converter to reach within a fraction of the final value.

STAIRCASE: A voltage or current waveform increasing in equal increments as a function of time.

QUANTIZE: The conversion of a continuous waveform (analog) into a series of discrete steps (digital).

QUANTIZING ERROR: The inherent error resulting from step representation of a continuous variable. The greater the number of steps (digital bits) the smaller the error.

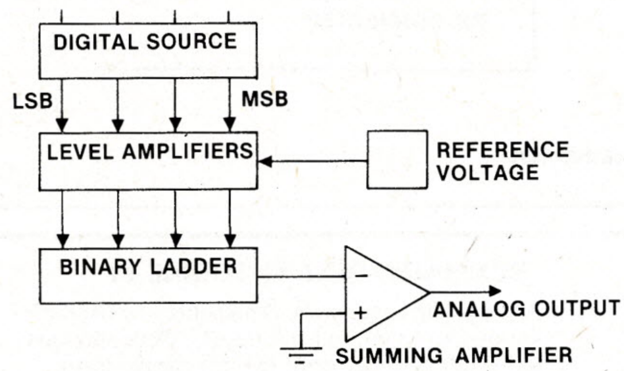


Figure 127. 4-bit D/A converter.

The block diagram in Figure 127 is representative of a practical 4-bit converter. The simplest converter would be that of a resistive ladder whose output was tied to the input of a summing amplifier.

The smallest increment of voltage in the analog output is determined by the least significant bit in the ladder. For a 4-bit ladder the smallest incremental change handled would be $\frac{1}{16}$ and for a 10-bit ladder the smallest increment of change would be $\frac{1}{1024}$. Say in both cases the full scale voltage (digital source) is 16 volts, then the smallest change in the output voltage of the 4-bit converter would be one volt. For the 10-bit converter the smallest change in output voltage that can be realized is 15.6 millivolts. Resolution may be expressed in percentage as well as voltage.

(a) 4-BIT LADDER $\frac{\text{1 volt step}}{\text{16 V FULL SCALE}} \times 100 = 6.25\%$

(b) 10-BIT LADDER $\frac{\text{15.6 Millivolt step}}{\text{16 FULL SCALE}} \times 100 = 0.0975\%$

The output deviation away from the theoretical analog output is referred to as the accuracy of the converter. Factors affecting the accuracy are due to ladder resistive tolerances, the reference power source, and parameters surrounding the summing amplifier.

TERMS — A/D CONVERTER

TRANSDUCER: A device that converts energy from one form to another.

RESOLUTION: Whereas the A/D converter utilizes a D/A converter in its circuitry, the resolution will be the same as that of the D/A converter.

ACCURACY: The closeness with which the digital output approaches the analog input.

COMPARATOR: A dual input device (amplifier) that compares two inputs, whereas the output is either in accordance or discordance.

CONVERSION TABLE: A measurement of the length of time it takes the A/D converter to produce a digital output.

COUNTER/RAMP TYPE A/D CONVERTER

A counter type of an A/D converter is represented by the block diagram of Figure 128. Here we see that the A/D converter is a little more involved than the D/A converter by itself.

The starter pulse serves a two-fold purpose: first it resets the counter, and second it gates a control circuit that feeds the counter pulses (clock) to start it counting. Since a 4-bit counter is utilized here, the digital output varies from 0000 to 1111. This digital count is then fed to level amplifiers to assure the individual pulses in the count representation are of the same voltage level.

These digital count pulses are then fed to the ladder network where conversion takes place. The output of the ladder is an analog step voltage which is utilized as a reference voltage. This reference step (staircase) is then applied to one

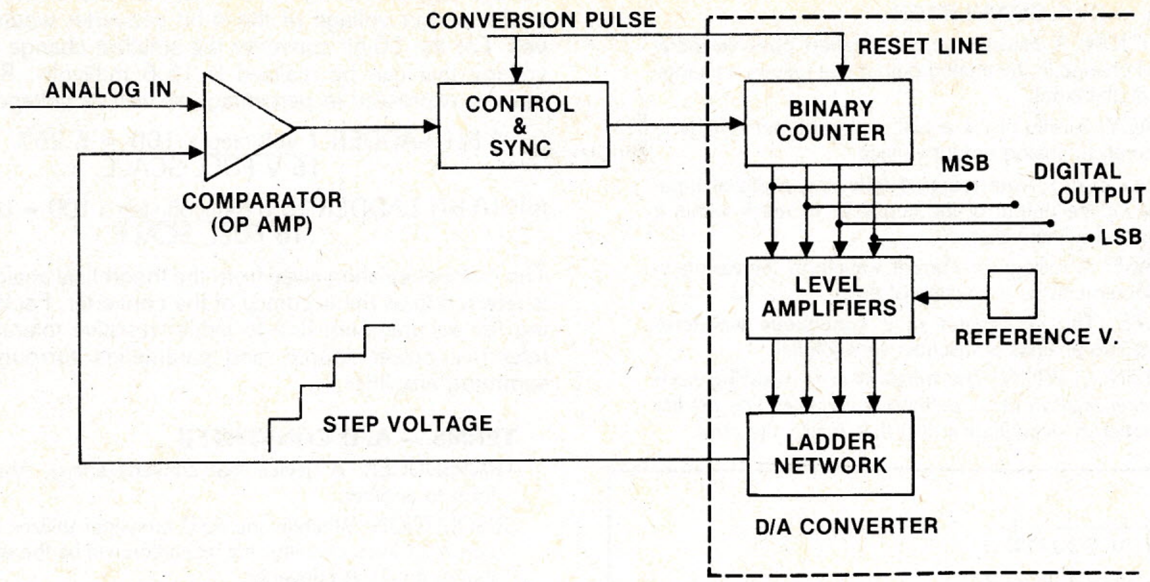


Figure 128. A/D converters

of the inputs to the comparator; the other output is fed by the external analog voltage.

The output of the comparator changes state at the voltage point where the external analog voltage and the analog reference step voltage are equal. This change of state of comparator output feeds the control circuitry which in turn blocks the pulse train triggering the counter. The digital output of the counter is now the digital equivalent of that point of the external analog input.

The next conversion pulse starts the conversion process all over again, producing a number of digital values which are representative of measurement points of the analog voltage.

There are many other methods utilized in the process of A/D conversion in addition to the counter method shown, among these methods are:

1. Direct comparison (simultaneous)
2. Continuous
3. Successive approximation
4. Dual slope integration

ENCODERS AND DECODERS

In the realm of spoken languages we run across two terms, *translate* and *interpret.* By definition, the term translate is defined as: change, convert into, rework. Conversely, the term interpret is defined: explain, define. In our digital world we use the terms *encode* and *decode.*

In a sense, when we put information into digital representation we are encoding (translating) and when we decode, we are taking digital information and defining (interpreting) it in another representation. As you can see, our point of reference is digital form. A/D converters are often looked upon as encoders and the D/A converter as a decoder.

In computer structures (including peripherals) there are certain requirements to be fulfilled by either translation (encoding) and interpretation (decoding). In the subsequent tutorials on microcomputers, the applicable encoders and decoders will be discussed.

Next month we can initiate our "leap" into the subject of Digital System Operation where investigation of timing and operating cycles takes place.☐

SUMMARY/QUIZ TUTORIAL #7

1. Analog data is generally represented by (A) continuous form; (B) pulse form; (C) discontinuous form; (D) discrete form; (E) interrupted form.
2. Sound is converted into digital form by (A) an A/D converter; (B) a D/A converter; (C) a transducer/AD converter combo; (D) a transducer; (E) sensor.
3. Digital information is generally fed into a binary ladder in (A) serial form; (B) parallel form; (C) series parallel; (D) paralleled series; (E) paraserial serial form.
4. The voltage output of a resistive ladder is (A) sinusoidal; (B) an analog step voltage; (C) digital; (D) discontinuous; (E) in sawtooth form.
5. Digital data can generally be described as being (A) in pulse form; (B) interrupted form; (C) discontinuous form; (D) discrete form; (E) in all of the above forms.
6. The smallest increment of voltage change that can be realized by a 4-bit ladder with a full scale voltage of 5 volts is (A) 312 millivolts; (B) 3.12 volts; (C) 1 volt; (D) 5 volts; (E) 0.5 volts.
7. The percentage of resolution for the 4-bit ladder in question number 6 is (A) .312%; (B) 3.12%; (C) 10%; (D) 6.24%; (E) 6.312%.
8. Which of the following D/A converters has the best resolution capabilities: (A) 8-bit; (B) 10-bit; (C) 12-bit; (D) 4-bit; (E) 16-bit.
9. In the counter type of A/D coverter the analog voltage staircase is used to (A) trigger the counter; (B) generate the start signal; (C) reset the counter; (D) generate the clock pulses; (E) as a reference analog voltage.
10. The A/D converter is sometimes considered (A) a decoder; (B) a transducer; (C) an interpreter; (D) an encoder; (E) an inverter.
11. Please rate the seventh unit of the NTS/INTERFACE AGE Mini Series. (A) Excellent; (B) Good; (C) Average; (D) poor.

Storage Technology: Solving 50% of a Problem

By Carl Warren, Editor-in-Chief

The one area of computer technology that has been a major stumbling block in the establishment of huge databases is the actual devices and media used.

As early as 1947, at Harvard University, storage was a major consideration on the Mark III series computers. Paper tapes, along with a steel oxide magnetic tape, were used as mass storage devices. By 1949, on the Univac BINAC system, steel oxide tape had found almost universal acceptance. There were problems associated with the steel oxide tape, and early computer professionals found that it had a short life expectancy. For important data storage and archive-keeping, paper card decks and paper tape seemed to fill the gap; at least for a time.

As the computer industry grew and began to be used more and more in business, the necessity of being able to retrieve data quickly became of prime importance to the computer user. Around the mid sixties, most major airlines were using computers to inventory seat space. American and Eastern Airlines pioneered the PARS — Passenger Airline Reservation System — which not only inventoried the number of available seats, but also allowed the creation and retrieval of passenger name records — PNRs.

This opened up a new era of data processing for the airline industry in particular, and for business data processing in general. More importantly, it demonstrated that digital computers using high speed storage devices could be used as an interactive business tool.

Like many things in the data processing world, as more capability was offered, more was expected by the end user. The spectrum of storage devices changed drastically, particularly in the modern era of data processing with massive databases.

CURRENT TECHNOLOGY

Today's marketplace is demanding even more of the computer and storage device maker. And they are more than prepared to meet the challenge.

Shugart Associates, probably the best-known disk manufacturer, was formed in 1973 with the idea of becoming the largest independent flexible (floppy) disk drive manufacturer, a goal which they have easily achieved.

The drive that Shugart is best known for is the SA 400, a 5.25-inch flexible drive designed to work with the small microcomputer systems. This drive provides a fair amount of

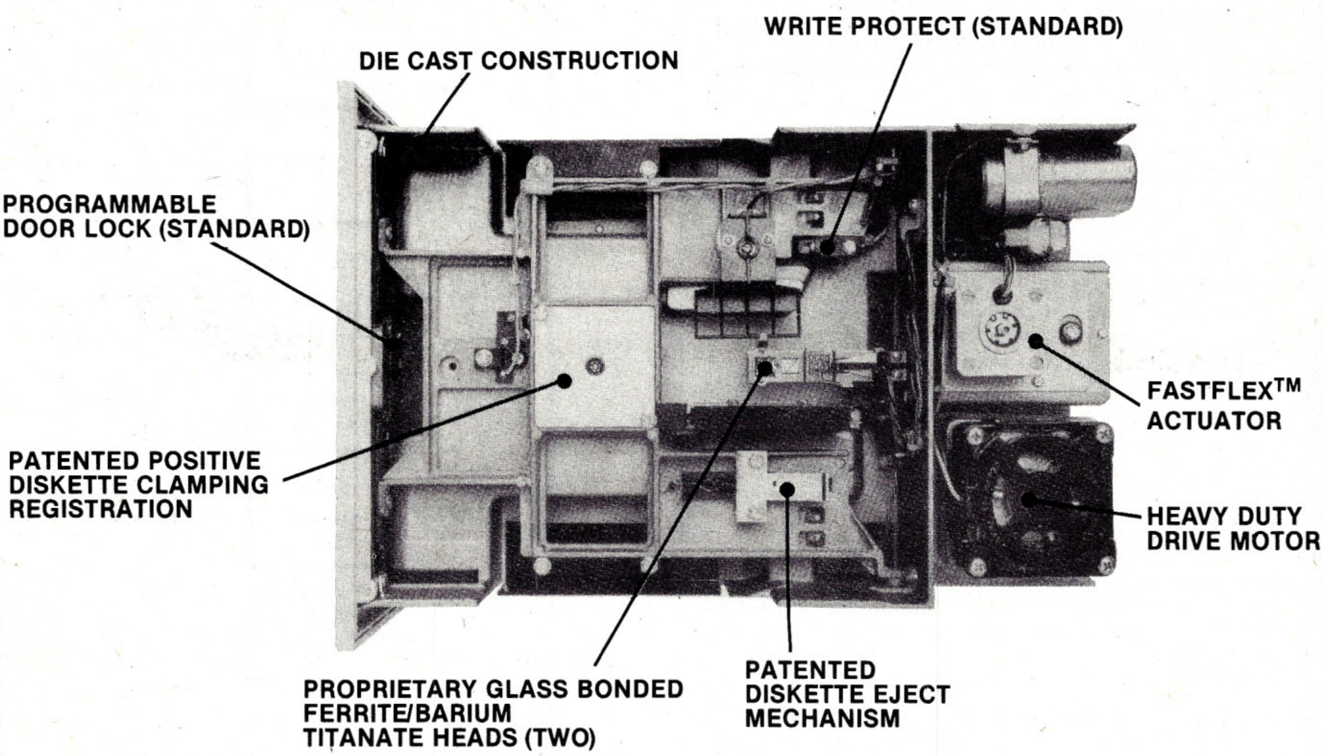


Figure 1. Various functional features of SA 850/851 drive. Provided courtesy of Shugart.

storage capability yet falls far short of what is necessary to meet most business needs.

Shugart has, however, developed products designed to meet the various storage requirements of the growing data processing community. These products include the SA 850 double-sided floppy drive, SA 450 double sided minifloppy, and the new SA 4000 fixed disk drive. Like most computer products, there has been a reverse pyramid growth effect, as shown in Photo 1. This is because different generations of users require different generations of hardware and capability.

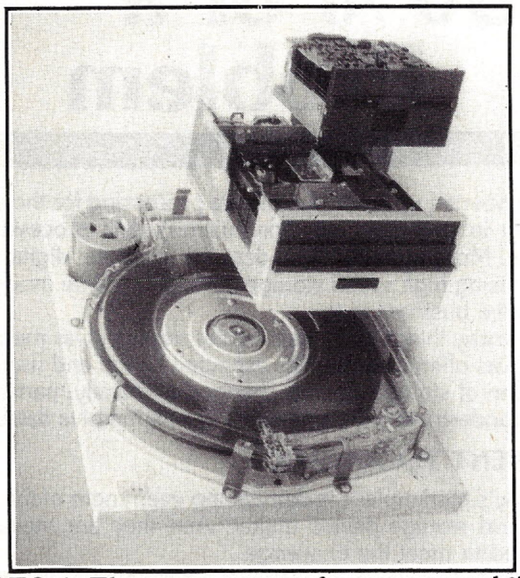


PHOTO 1 The generations of storage capability — SA 400 to SA 4000. Courtesy Shugart

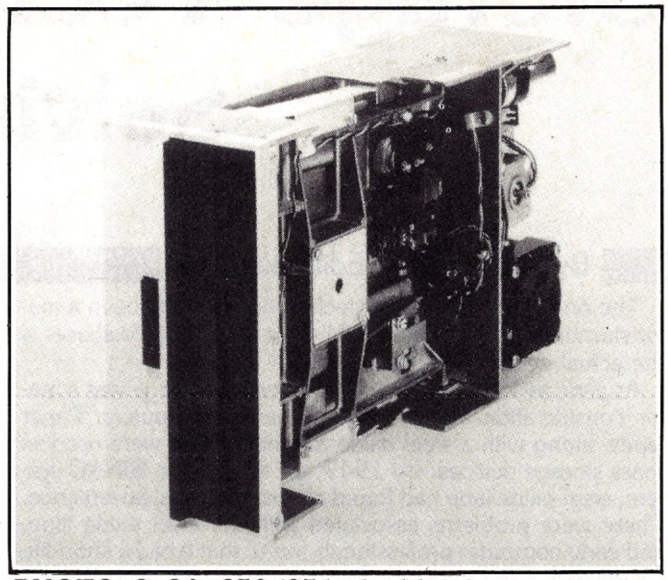


PHOTO 2 SA 850/851 double density flexible drive. Courtesy Shugart

The SA 850 Flexible Drive

The SA 850 flexible drive is a significant entry into the disk marketplace since it does offer high density recording, up to

SOME NOTES ABOUT DISKS

People have a tendency to view high technology items such as disks with a great deal of trepidation, assuming that they would never be able to have an understanding of what makes the system work. Disk technology is probably one of the least awesome technologies used in the computer industry, since it is a direct outgrowth of the average phonograph.

To understand disk systems, think of the family stereo. There is a turntable with a spindle in the center to hold the record. A disk drive is designed in a similar manner. The disk, which looks like a 45 rpm record for 5.25-inch disks and about the same for 8-inch disks only larger, is held in an envelope to protect the magnetic surface. The disk fits on a spindle inside the drive that turns it at high rotational speeds several times faster than a conventional record player.

The record player has an arm with a needle to ride in the grooves on the record to pickup the recorded music. Within a disk system, the needle is replaced with a special head that is designed to vibrate at much higher speeds than could be achieved by a needle arrangement.

This head, made of special crystals, is mounted on an arm called a positioner. It is controlled by an actuator. The positioner moves the head across the media laterally to specific areas as requested by the computer programs.

Floppy or flexible disk systems allow the head to ride directly on the media when the system is in operation, much like a phonograph. Hard disk systems, which use special lubricated media and rotate at much higher speeds, use flying heads. As the system operates, the read/write heads float a hair's breadth above the mag-

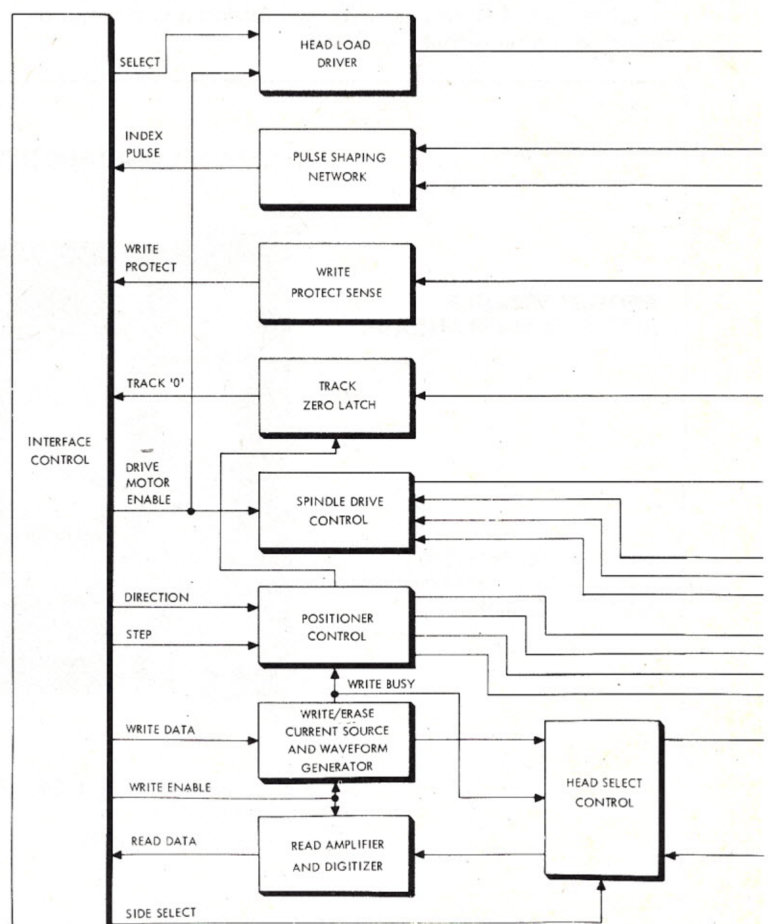


Figure 1.

160,000 characters on a removable media. The drive, Photo 2, uses a ferrite barium titanate head and a new FastFlex™ actuator which is designed to provide faster access speeds. Figure 1 shows the various features of the SA 850 drive.

FIXED DISK TECHNOLOGY

Even with all the improvements in flexible disks, from reliability to recording density, they still do not provide sufficient storage for all business needs. Fortunately, the necessary storage capabilities do exist with hard or fixed disk technology.

The three companies with the most significant hard disk offerings are: Shugart's SA 4000 14-inch hard disk, Pertec's 8-inch D8000, and New World's 8-inch MIKRODISC™. All three of these hard disks use Winchester or 3350 technology.

This technology, developed by IBM, uses non-removable media with a flying read/write head. The media is a ferrite coated aluminum platter that is coated with a special lubricant to prevent media damage when the head takes off and lands during start and stop sequences. Due to the nature of Winchester-type drives, a sound similar to the winding up of a jet engine is heard when the system is first activated.

Shugart bills their SA 4000 as the natural evolution in disk technology. It is a 14-inch drive incorporating low mass Winchester-type flying heads. The disk allows for up to 29 million characters of storage at a cost of less than $2,000 to the Original Equipment Manufacturer (OEM).

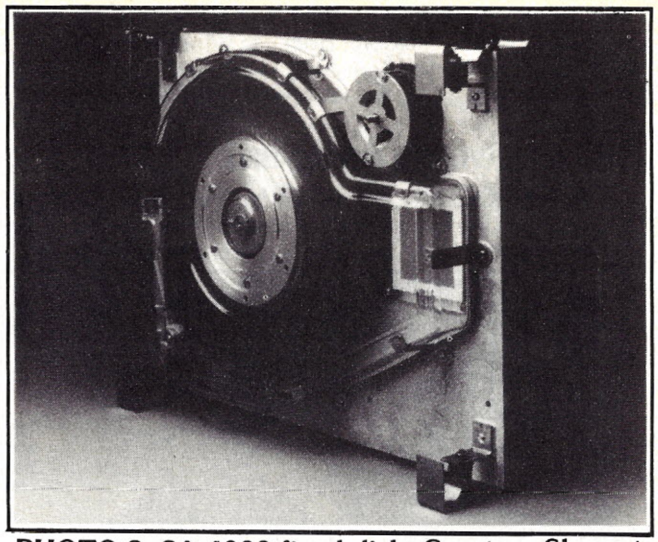
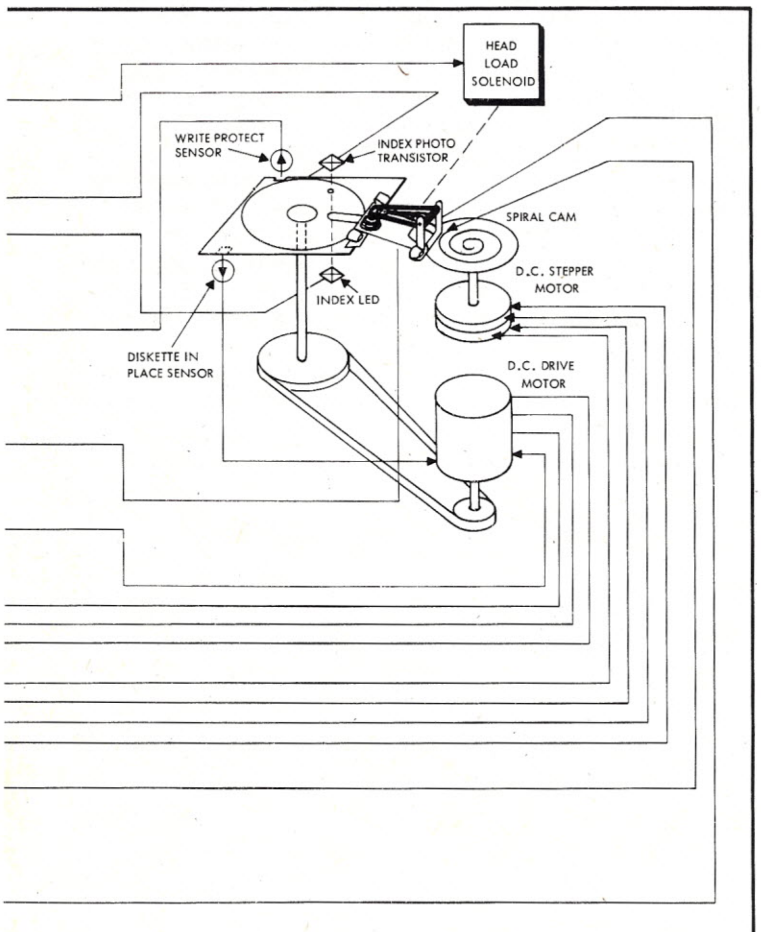


PHOTO 3 SA 4000 fixed disk. Courtesy Shugart

The drive as designed is primarily for the high end data processing center that requires high track density and ease of retrieval. The SA 4000, Photo 3, is a closed system as Winchester technology dictates. It uses the FastFlex actuator. The platter rotates at 2,964 RPM.

THE 8-INCH HARD DISKS

Within the scope and nature of changing storage technologies, the 8-inch fixed disk was the next obvious transi-



Functional operation of disk system. Courtesy Pertec

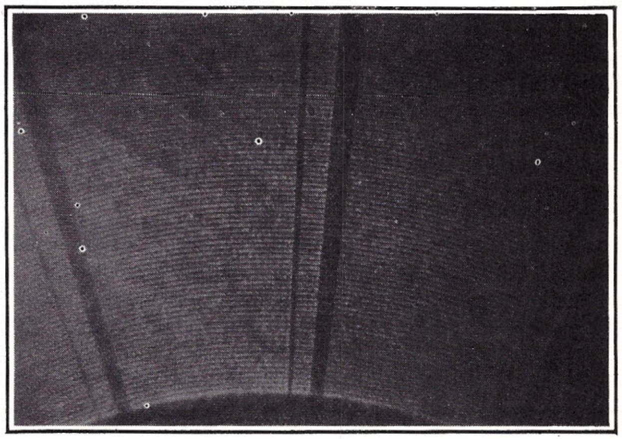


PHOTO 1 Example of recording tracks on floppy disk media. Courtesy Verbatim

netic surface. Consequently, a great deal of care must be taken to ensure that the unit is not in a dirty environment. The manufacturers of hard disk systems encase the media in special enclosures and provide sophisticated filtering systems to prevent contamination.

For both flexible and hard disks, the information contained on the magnetic media is read just about the same way a phonograph record's information is interpreted. The head or needle comes across the information, vibrating at a specified frequency that directly translates into some meaningful information, music, or in the case of disks, data. This information is then sent to other electronics in the system that format it into some understandable form — sound from the phonograph or a computer display from a disk.☐

tion. As mentioned, Pertec and New World's fixed disk entrants fall into this category. Both use Winchester technology and high speed data transition read/write circuitry. From these basic points on, the two drives differ as much as night and day.

THE NEW WORLD MIKRO-DISC

The MIKRO-DISC, introduced by New World Computer Company, is the first fixed disk drive for less than $1,000 in OEM quantities. The new disk system allows for up to 2.1 million characters of storage and high speed data access.

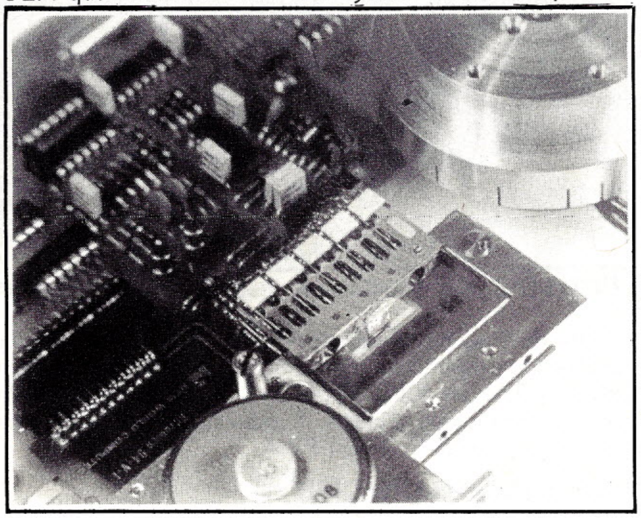


PHOTO 4 MIKRO-DISC™ twenty read/write heads. Courtesy New World

The unique feature of the MIKRO-DISC is the twenty read/write heads, as shown in Photo 4. This feature means that over 250,000 characters of data are available on one disk rotation. This improves data throughput and makes the unit extremely acceptable for industrial control applications. The secret to the data flow lies not only in the 20 read/write heads but also the short-stroke stepping motor that provides for a head positioning time of approximately 5 milliseconds.

PCC's D8000 8-inch Fixed Disk

The D8000 8-inch fixed disk recently introduced by Pertec Computer Corporation Peripherals Division, represents a significant advancement in the disk storage arena for Pertec. To fully understand the significance of the D8000 drive, the total storage picture must be viewed.

Storage systems fall into two distinct types: tape and disk.

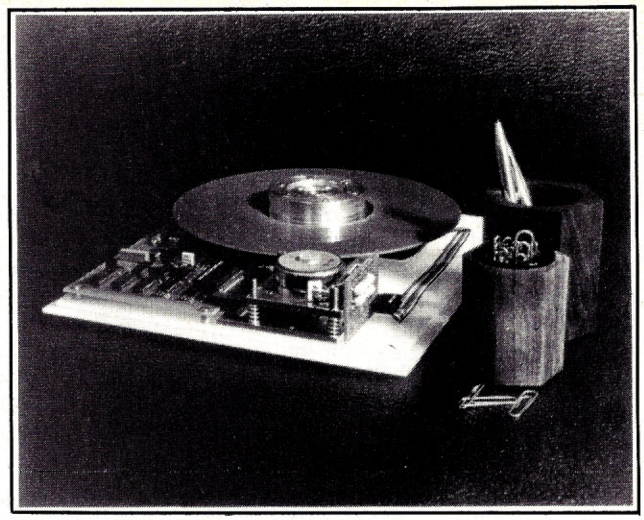


PHOTO 5 MIKRO-DISC™ relative physical size of disk. Courtesy New World

Tape includes vacuum column drives, tension arm tape drives, 3M/Phillips cartridge systems, and streamer tape systems. Pertec has maintained a lead in the tape transport business with such products as the FT 6250 tape transport subsystem, Photo 6.

Pertec has taken an approach to cover both tape and disk technologies. The reasoning is quite simple from the onset. High density disk technology had reached a reasonably satisfactory development state by the time Pertec came on the scene. Pertec filled the big hole in the tape market, particularly for the so-called super mini market. This was important because it provided a means of back-up for the high density disks.

Through the natural evolution of technology and market evaluation, the Pertec direction pointed to filling the disk storage gap that existed between the 256,000 to 1.2 million character floppy disk and the 80 to 150 million character fixed disk systems. Thus was born the genesis of the D8000 20-million character, 8-inch hard disk system, Photo 7.

During the planning stages of the D8000, the following criteria were established: the physical size of the drive must be the same as a dual headed floppy, to make it mechanically interchangeable. The unit must operate with the same voltages as the floppy system, and have a storage capacity in the 20 million character range. To make the unit industry acceptable, it should sell for around $1,800 OEM.

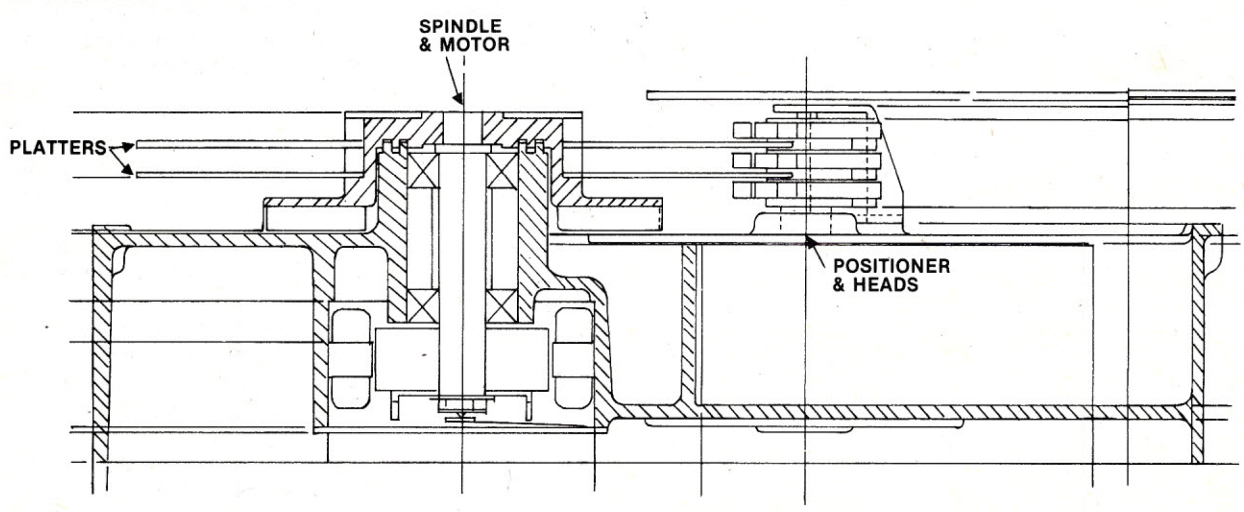


Figure 2. Cross section of D8000, courtesy of Pertec.

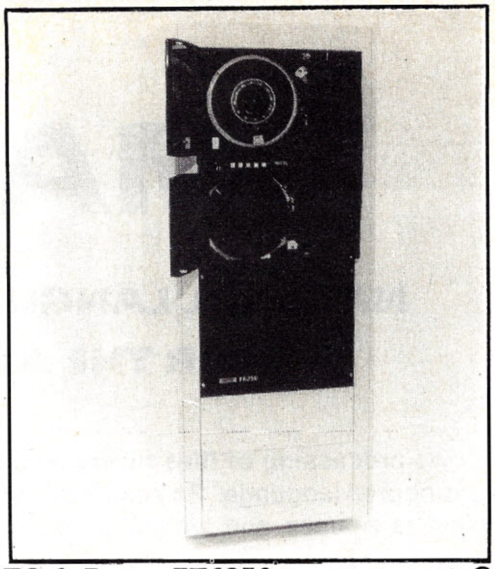


PHOTO 6 Pertec FT6250 tape transport. Courtesy Pertec

Inside the D8000

The D8000 uses two platters — four surfaces, three of which are for data, the fourth is a servo surface. The servo surface contains the track information which is pre-recorded before the media module is assembled. The servo is essentially a track following system — the head reads the track information from the servo surface and sends it to the servo mechanism.

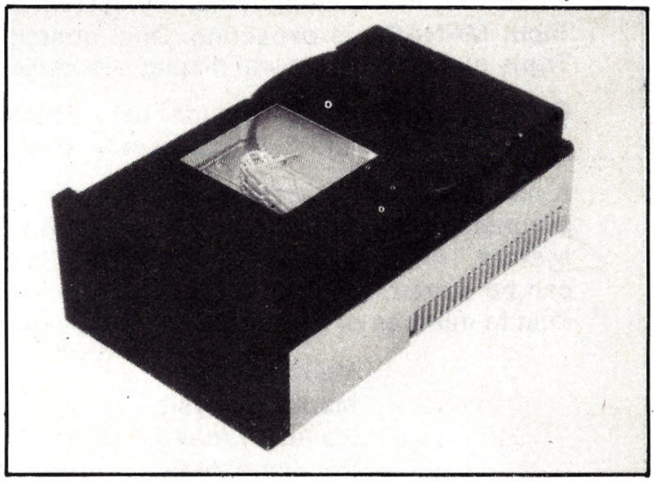


PHOTO 7 D8000 8-inch hard disk. Courtesy Pertec

Pertec uses a DC rotary motor positioner rather than a voice coil to permit head movement in very small increments; as little as one track at a time or as many as necessary. Figure 2 is a cross-section view of the D8000 showing the relative placement of the various functional components. Photo 8 shows the DC rotary positioner arm and head assembly.

To enhance the practicality of the drive and reduce interface[1] costs, the D8000 uses a Motorola 6801 microprocessor[2] for controlling internal drive functions plus facilitate the movement of data to and from the computer's bus.[3] Figure 3 is a functional block diagram of the D8000 operation.

WHY ONLY 50% OF THE PROBLEM?

With the introduction of innovative disk technologies, a paradox has been created. At the high end — large disk systems with large prices — companies such as Pertec were able to provide high density, maximum storage tape subsystems for back up at high end prices. The paradox is that as the physical size and prices of disks decrease, and storage densities increase, the problem of backup becomes of prime

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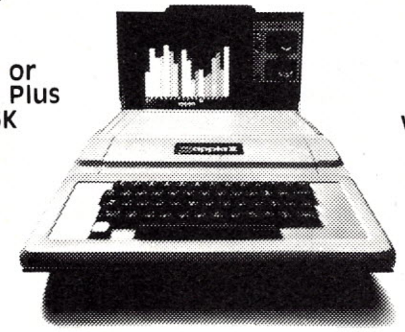

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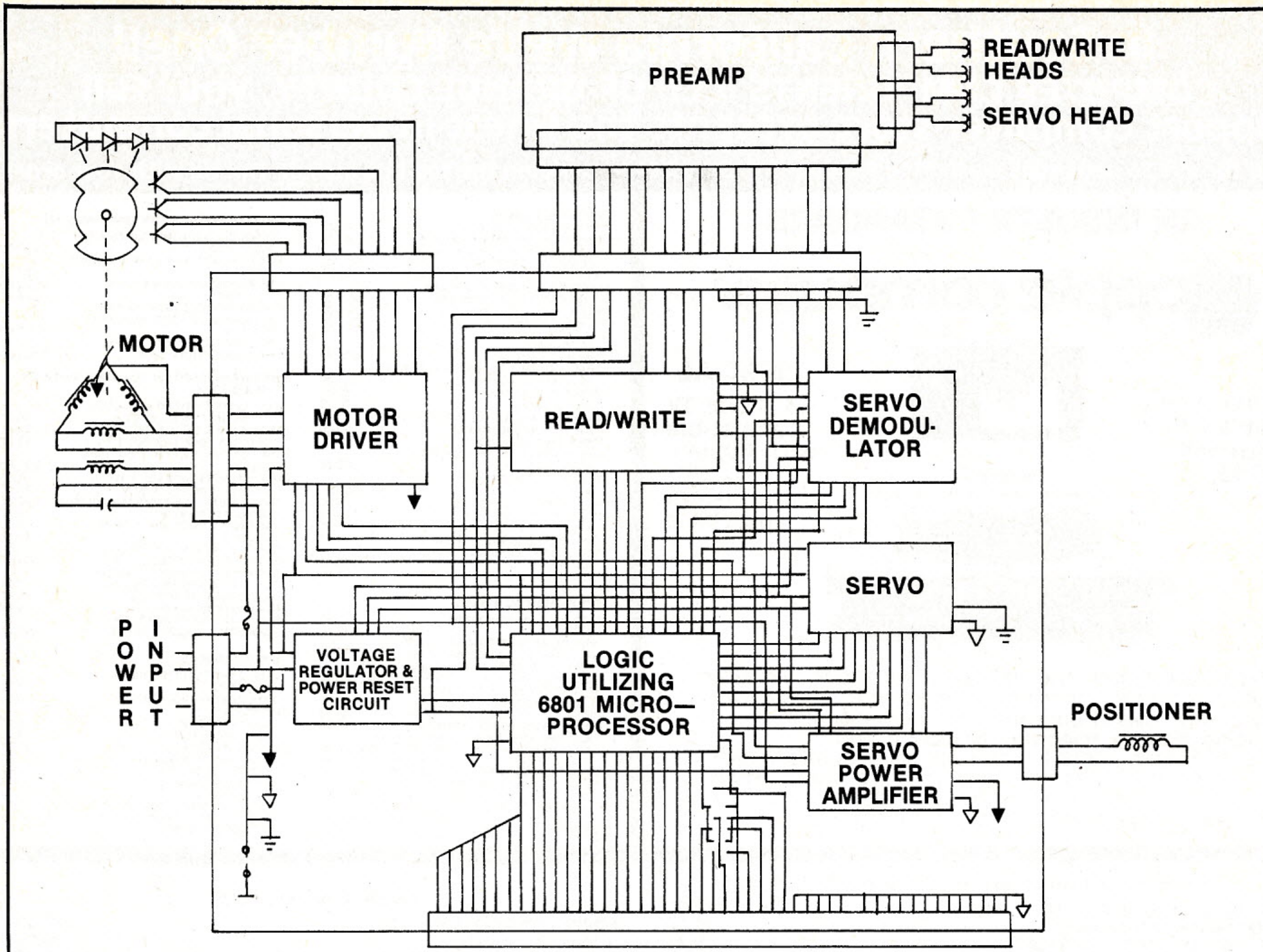

Figure 3. Functional block diagram of D8000, courtesy of Pertec.

consideration. The problem is trying to back up 20 million characters of information for a reasonable price.

Currently the only way to back up high density disks is with extremely expensive tape subsystems or with multiple

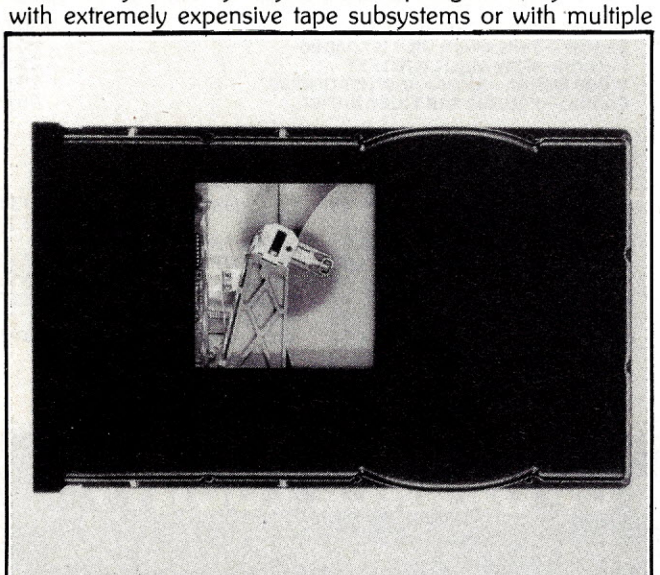

PHOTO 8 D8000 positioner and head assembly. Courtesy Pertec

flexible drives. Obviously a storage gap has been created which in turn is creating research into new backup technologies and refinement of older existing technologies.

WHAT THIS MEANS TO THE BUSINESSMAN

Newer mass storage devices mean that the small businessman can, within the next few years, really have the power of large computer systems for a fraction of the cost. Even possibly more exciting is that the average business will be able to afford to maintain very large databases without worry about changing of media or maintaining multiple drives.☐

[1]Devices such as disk drives must be connected or interfaced to the computer with a special set of electronics called an interface. The purpose of the interface is to allow two dissimilar components to communicate with each other.

[2]The Motorola 6801 microprocessor is one of the newer computer chips on the market. This computer chip contains all the electronics necessary to function as a computer, which makes it ideally suited for control applications such as the one described in this article.

[3]The term bus essentially means the unique electronic path that is used by a computer to send digital information to and from different parts of the total computer system. For instance, the term data bus refers to that series of physical paths data must take to be of the most use to the central processor, and ultimately to the entire computer.

Shugart Associates can be contacted at 415 Oakmead Parkway, Sunnyvale, CA 94086. New World Computer Company is located at 3176 Pullman Street, Suite 119, Costa Mesa, CA 92626. Pertec Computer Corporation's address is 21111 Erwin Street, Woodland Hills, CA 91367, Attention: Carol Hays.

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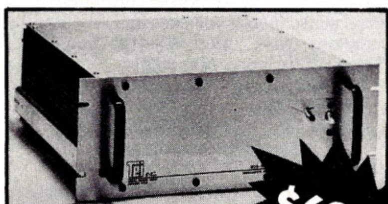

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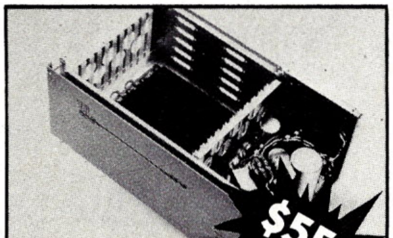

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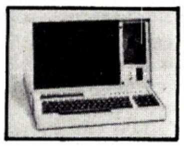

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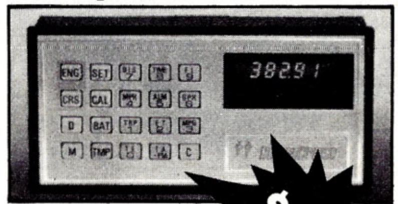

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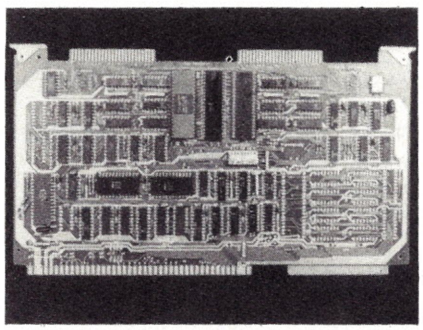

The iSBC 204 Universal Flexible Diskette Controller can control two single-headed drives or one double-sided drive in its standard configuration. With the addition of a single plug-in component this capacity can be doubled.

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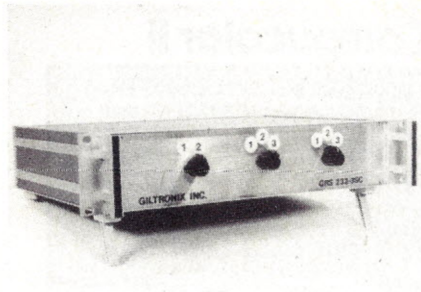
RS232 Controllers

Giltronix Inc. introduces a new family of rack mountable RS-232 switching and monitoring units. The new family will allow the user to switch and to monitor any RS-232 interconnect system.



The new units are ideal for technical control facilities as well as for laboratory use. The units can be mounted in standard 19" racks or can be used as desk top units. Models GRS-232-SC, GRS-232-2SC and GRS-232-3SC have one, two and three swiching modules respectively.

For more information contact Giltronix, 3156 Avalon, Palo Alto, CA 94306.

CIRCLE INQUIRY NO. 124

Journal of Computational Chemistry

John Wiley & Sons announces a new quarterly, the *Journal of Computational Chemistry*. The first issue will appear next spring. The journal will be edited by Normal L. Allinger of the University of Georgia.

The journal will publish original articles concerned with all aspects of computational chemistry — organic, inorganic, physical, or biological. Experimental or theoretical work will be welcome provided the main thrust is computational.

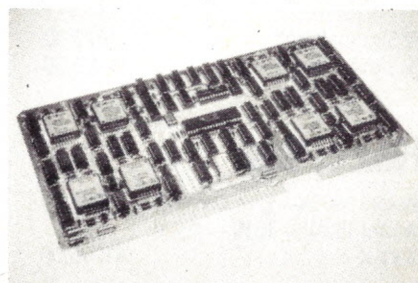
Annual subscriptions will cost $50. Write to the Subscriptions Dept., John Wiley & Sons, 605 Third Ave., New York, NY 10016.

Prospective authors are invited to write to Dr. Allinger at the Department of Chemistry, University of Georgia, Athens, GA 30602.

CIRCLE INQUIRY NO. 125

Bubble Memory for SBC-80 Computers

The new Bubbl-Tec division of PC/M, Inc. has available ready-to-operate magnetic-bubble mass-storage memory add-ins for the SBC-80 family of single-board microcomputers originated by Intel.



Other manufacturers of SBC-80 type machines now include National Semiconductor, Monolithic Systems and others.

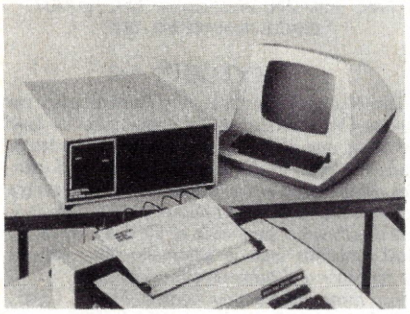
Designated the MBB-80 Bubbl-Board™, the new SBC-80 compatible bubble-memory system is entirely contained on a single multi-layer printed circuit modules that consumes just one slot in the SBC-80 card cage. Non-volatile storage is provided for 92,304 bytes of data.

Price is $1695. For details contact Al Foreman at Bubbl-Tec, 3120 Crow Canyon Rd., San Ramon, CA 94583, (415) 837-7150.

CIRCLE INQUIRY NO. 126

New Small Business System

The Series 5000 computer system is a compact but powerful system designed to meet the needs of small businesses. The Series 5000 is a logical combination of many component products previously sold separately by Industrial Micro Systems.



The system is comprised of an 8080 CPU board, 5¼" disk drives and RAM memories and is offered in desk-top or desk enclosure versions. The Series 5000 can accommodate up to three 5¼" floppy disk drives for up to 1 megabyte of storage. With the IMS RAM boards, up to 300 kbytes of main memory can be directly addressed.

Two operating systems are currently available, the well-known CP/M and the MVT-FAMOS multi-user, multi-tasking system.

For details contact Industrial Micro Systems, 628 N. Eckhoff St., Orange, CA 92668, (714) 633-0355.

CIRCLE INQUIRY NO. 127

Dual Redundant QPSK Modem

Aydin Monitor Systems' Model 2706 Dual Redundant QPSK Modem offers a high availability communications link for critical data paths. The unit features dual modulator/encoders and dual demodulators/decoders interconnected to switching networks.

Each unit features internal faul sensing which causes an automatic switchover to the standby unit. The demodulator data output is further processed by a convolutional decoder and bit synchronizer. Data scrambling ensure broad spectral distribution of the modulated carrier.

For more information contact Aydin Monitor Systems, 401 Commerce Dr., Fort Washington, PA 19034.

CIRCLE INQUIRY NO. 128

Light Pen and Pick-Module

Megatek Corporation has available a light pen and pick-module for use with its recently-introduced Whizzard 7000 serie of vector refresh graphic terminals and systems. The light pen and pick-module feature automatic highlighting to provide the user with real-time feedback while working at the Whizzard display.

The light pen's built-in highlighting feature causes any vector or character to blink when the user points to that item on the screen with the light pen.

The pick-module is essentially a digital light pen which can be tied to either joystick or digitizer inputs.

For more information contact Megatek Corp., 3931 Sorrento Valley Blvd., San Diego, CA 92121, (714) 455-5550.

CIRCLE INQUIRY NO. 129

Interactive Compiler for Micros

Interactive Microware, Inc., has available BASEX, a compact high-speed interactive compiler, which is a new intermediate-level language for microcomputers that combines the best features of both BASIC and EXecutable machine language code.

The BASEX compiler is fully interactive and allows you to enter, list, edit and run your program without the help of any auxiliary programs, such as editors or linkage editors.

Most BASEX commands resemble their counterparts in BASIC, which makes BASEX an easy language to learn and speeds up the translation of programs from BASIC to BASEX.

The major advantage of using BASEX is that programs run up to 20 times faster than similar BASIC programs.

For more information contact Interactive Microware Inc., c/o Marketing Information Services, 5082 Shirley Drive, La Palma , CA 90623, or call Paul Warme at (814) 238-8294.

CIRCLE INQUIRY NO. 130

Lifeboat Supports Helios

Owners of Processor Technology's Helios II disk system are assured of continuing independent software support from Lifeboat Associates. Lifeboat is committed to providing the finest software available for all popular formats, including North Star, Micropolis, iCOM, SD Systems, Dynabyte, DB 8/2, Helios, Altair, 8" IBM and Ohio Scientific.

For more information contact Lifeboat Associates, 2248 Broadway, New York, NY 10024, (212) 580-0082.

CIRCLE INQUIRY NO. 131

High Resolution Graphics Controller Module

Matrox Electronic Systems announces a self-contained, bus independent high resolution graphics control module. Directly connected to a standard TV monitor and easily interfaced to any mini or microcomputer, the MMD-256 provides a cost effective, off the shelf solution to many graphics problems.

A single 4.5" x 6" x .5" high module is a complete 256 x 256 x 1 graphics subsystem. The CPU interface to any VRAM is as simple as interfacing normal static RAMs and may turn the video on or off, and single command erase the screen. The X-Y addressing scheme allows the operator complete screen access, read or write, on a pixel by pixel basis.

Price is $495 for one. For more information contact Matrox Electronic Systems, 5800 Andover Ave., Montreal, Quebec, Canada H4T 1H4, (514) 735-1182.

CIRCLE INQUIRY NO. 132

Precision Alignment Cassette

Verbatim Corporation's new precision alignment cassette is designed to simplify and upgrade electronics testing of digital cassette transports. The recording on the cassette allows more accurate adjustment of skew and timing because of built-in precision guides.

Designated the OSX-1000, each cassette contains 282 feet (86 meters) of computer grade tape, pre-recorded with saturated full-width pulses, accurately spaced and aligned to the tape edge.

Price is $50. For more information contact Verbatim Corp., 323 Soquel Way, Sunnyvale, CA 94086.

CIRCLE INQUIRY NO. 133

MICRO-68 Price Cut

Electronic Product Associates announces a drastic price cut in its basic microprocessor, the Micro-68a. This little system comes completely assembled and ready to use. Built around the Motorola/AMI/Hitachi 6800 microprocessor, the EPA system features an integrated power supply, hexadecimal keyboard, 6-digit LED display,

512 words of PROM (expandable) and 128 words of RAM (also expandable). Edge connectors allow for additions to the basic system.

Price is now $399 complete. For more information contact Electronic Product Associates, Inc., 1157 Vega St., San Diego, CA 92110, (714) 276-8911.

CIRCLE INQUIRY NO. 134

NCE Summer Catalog

Newman Computer Exchange has available a new catalog which they are offering free for the writing. This big, fully-illustrated, 48-page catalog describes both their giant inventory of minicomputers and peripherals and their complete product line of microcomputers, terminals and peripherals in depth.

The microcomputer section is packed with photos and text presenting latest manufactuters' information and specs. Five pages have been devoted to terminals with instructions explaining how they may be leased or bought outright.

For a free copy, contact Newman Computer Exchange, Inc., P.O. Box 8610, Dept. LBUP, Ann Arbor, MI 48107.

CIRCLE INQUIRY NO. 135

1978 Catalog of Tab Books

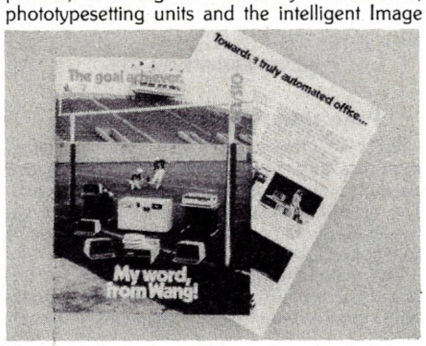
Tab Books has available its 1978 catalog describing over 600 current and forthcoming technical and do-it-yourself books with topics ranging from Aviation to Computers to TV Manuals to Vans.

For a free copy contact Tab Books, Blue Ridge Summit, PA 17214.

CIRCLE INQUIRY NO. 139

Wang Info

A two-page black and white brochure describes the Office Information System (OIS)/130 from Wang. The system accommodates up to 14 peripherals, including 32K memory workstations, phototypesetting units and the intelligent Image



Printer. It features a 10-megabyte hard disk to store up to 4,000 pages of text.

For details contact Wang Laboratories, Inc., One Industrial Ave., Lowell, MA 01851, (617) 851-4111.

CIRCLE INQUIRY NO. 137

TRS-80 Journal

Insiders: the TRS-80 hardware journal with machine software is a publication for any TRS-80 owner or user interested in more than BASIC. Both beginners and experts will find articles on machine language programming, hardware modifications, and other computer languages. Each issue covers a variety of subjects.

Regular features include a Column on Printers which reviews various printers, the Disc File which covers the latest in DOS and compatible drives, and Learning Machine Language with Level II.

Insiders subscriptions are available at $7.50 for 6 issues thru Computer Cablevision, 2617 42nd St. NW, Suite 2N; Washington, D.C. 20007.

CIRCLE INQUIRY NO. 140

MYTOS™

The Mykro Tape Operating System uses the Kansas City standard audio frequencies for tape recording and goes four times as fast. It writes or reads 8K bytes in 75 seconds instead of 5 minutes. Also, many existing 300 baud K.C. readers will read the 1200 baud output of MYTOS.

MYTOS writes and reads all file bytes verbatim. Most functions include automatic start/stop for the recorder and optional console display.

For more information contact Mykro Corp., P.O. Box 61644, Sunnyvale, CA 94088.

CIRCLE INQUIRY NO. 141

XEK Executive Package

XEK is a disk based North Star executive package consisting of an assembler, disassembler, debugger, monitor and line oriented editor. Provisions are made for six active source files in RAM with the usual mass storage on disk.

The assembler generates object code that may be located anywhere in memory. The disassembler provides commands for ASCII and hexadecimal dump of memory, cross reference symbol table, list formatted or unformatted and disassemble from specific memory address. The editor has an "auto-line" feature to simplify source generation.

Price is $49.95. For details contact Byte Shop of Westminster, 14300 Beach Blvd., Westminster, CA 92683, (714) 892-0500, Nelson Riegel.

CIRCLE INQUIRY NO. 142

Product Development Systems

The PDS 8000 Product Development Systems is a family of modular, easily expandable systems designed to support development of Z8, Z80 and Z8000-based microcomputer designs.

Available in free-standing or rack mounted enclosures with a choice of floppy or hard disk storage, the PDS 8000 systems feature 64K bytes of memory, printer interface, 1920-character CRT console and RS232C console interface.

For details contact Ron DeJong at Zilog, 10340 Bubb Rd., Cupertino, CA 95014, (408) 446-4666.

CIRCLE INQUIRY NO. 143

TRS-80 and Exidy Software

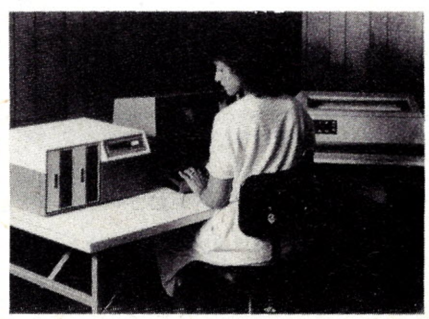
Statpak has five programs: ANOVA, T-test, Linear Correlation, Analysis of Covariance, and Generalized Statistics. MoneyOne consists of four programs: Loans, Networth, Budget and Checkbook. Price is $11.95 each on cassette.

All Basically Speaking software includes full documentation, quality media, and periodic updating. For details contact Basically Speaking, 719 Anna Lee Lane, Bloomington, IN 47401.

CIRCLE INQUIRY NO. 144

Multi-Station Word Processor

The CMG Omicron Word Processor is a microprocessor based system that handles up to 8 terminals to facilitate letter, proposal and other document preparation.



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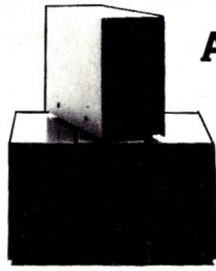

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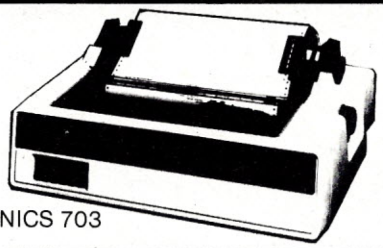

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LP703 Centronics	$2540
LP1 Centronics P1	$ 399
Centronics cables	$ 39

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Apparat, Inc.

The Omicron incorporates a Zilog microprocessor, printer, 12" diagonal CRT with keyboard, and 2 floppy drives.

Price is $12,990 for single station. For details contact Computer Management Group, Inc., P.O. Box 4721, Elm St., Merrimack, NH 03054, (603) 424-9947, Wm. Pellow, Mktg.

CIRCLE INQUIRY NO. 145

Pascal Processor for S-100 Bus

The Pascal-100 Processor is a 16-bit central processor board for the S-100 bus designed for use with the Pascal programming language.

The Pascal-100 processor directly executes P-code instructions generated by the Pascal compiler written at the University of California, San Diego (UCSD Pascal). This makes unnecessary the software P-code interpreter formerly required for S-100 implementations of UCSD Pascal and runs five to ten times faster than such systems.

Other features of Pascal-100 include support of up to 128K bytes of directly addressed main memory, 16-bit data bus transfers, vectored interrupts and floating point operations.

Price is $995. For details contact Digicomp Research Corp., Terrace Hill, Ithaca, NY 14850, David Lewis.

CIRCLE INQUIRY NO. 146

REX-80

REX-80™ (Real-time Event-driven Executive) is a real-time, multi-tasking executive designed for 8080 and Z-80 based microcomputers. It provides a system design tool for industrial applications such as process control where the program requirements of real-time interrupt processing, concurrent execution of multiple programs and the sharing of system resources have previously been handicapped.

One time license fee is $1,500. For details contact Systems and Software, Inc., 2801 Finley Rd., Suite 101, Downers Grove, IL 60515, (312) 932-9320.

CIRCLE INQUIRY NO. 147

Mailing List Software

The Commercial Mailing System is a series of programs written in Computerware's Random BASIC for maintaining a mailing list on disk. Since it was written with Random BASIC ti provides on-line access and update capability of any record in the file.

This system can only be run under Smoke Signal Random Access Disk Operating System. All fields (except date) in the system allow alphanumeric data. Some of the features of the system include the address label printing that can be directed to any port (0-7), the drive on which the data file resides is operator selectable, optional special code and phone numbers may be maintained, label spacing is operator selectable, a date is maintained with each name (with birthdate, expiration date, etc.), and sorted reports or labels can be requested by a range of values of any one of the following fields: date, code, zip, or name.

The facility is provided to maintain and print either a title or a country in the label or report. Price is $89.95. For details contact Computerware, 1512 Encinitas Blvd., Encinitas, CA 92024, (714) 436-3512.

CIRCLE INQUIRY NO. 148

Intel Offers ANSI COBOL

Intel has available COBOL for use on Intel microprocessor development systems. The Intel iCIS-COBOL (Intel Compact Interactive Standard COBOL) is a powerful interactive COBOL program development package.

iCIS-COBOL contains a COBOL compiler, a run-time system, an interactive debugger and other utility programs designed to facilitate rapid program development. It exceeds the minimum ANSI Level I standard and is specifically designed to add value to Intellec™ development systems by providing ancillary COBOL program development and processing capabilities.

For more information contact Intel Corp., 3065 Bowers Ave., Santa Clara, CA 95051, (408) 987-1010, Mike Peak.

CIRCLE INQUIRY NO. 149

Keyed File Management System

MAGSAM™ is a keyed file management system designed for the CP/M operating system. MAGSAM enables users of CP/M and CBASIC to create and access data records quickly and directly by user defined keys.

Records may be retrieved randomly by key, sequentially by key, generically by key (wild card search), sequentially in physical (chronological) order, and randomly by relative record number.

Records may be created randomly by key and sequentially by key, and updated by any of the retrieval methods.

MAGSAM runs as a subroutine to CBASIC programs and requires 6K of memory over that occupied by the operating system and the calling program.

Prices start at $75. For details contact Micro Applications Group, 7300 Caldus Ave., Van Nuys, CA 91406.

CIRCLE INQUIRY NO. 150

Database Management System

GLOBAL is a comprehensive and versatile user-oriented database management system for database creation and list maintenance. GLOBAL runs under CP/M and CBASIC2 on a microcomputer system in only 40K RAM.

Some features include user-defined file structure with sequential, random and linked file maintenance; user defined number of fields, data transfer between records; automatic high speed search algorithms, links to CP/M commands or programs with automatic return to GLOBAL; provides status reports on diskette, data file and hardware environment; disk used as extended memory and more.

Price is $295. For more information contact Global Parameters, 1505 Ocean Ave., Brooklyn, NY 11230, (212) 252-5002.

CIRCLE INQUIRY NO. 151

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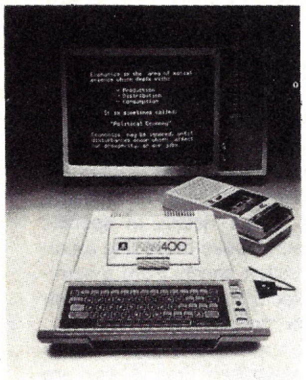

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BOOK REVIEWS

MICROCOMPUTER SYSTEMS PRINCIPLES
Featuring the KIM/6502
By R.C. Camp, et al. 547 pages
Matrix Publishers, $16.95
Review by Dana Majewski

This book is primarily a textbook, covering most aspects of microcomputer systems. Much of the information, however, could be of interest to the business user, hobbyist and others involved in microprocessor applications.

The book starts out with a broad overview of the history of electronics leading up to the microprocessor, its applications and the engineering of microprocessor products. The demands of education created by the microcomputer are also discussed.

To give a feel for computers in general, the book covers the general aspects of all computers including types of instructions, arithmetic operations, addressing modes, character and number representation, and peripherals. The concepts of subroutines and interrupts are discussed in some detail, including the interaction with external devices through the use of interrupts. Also included is a brief discussion of the technology applied in microprocessors such as chip size, element density and TTL logic.

The 6502, 6800 and 8080 microprocessors are covered quite extensively. The specifications, instruction sets, and characteristics of all three are given. The comparisons include addressing modes, data paths, and power supply requirements. Sample programs are given for each of the microprocessors.

The authors explain how software can ease the job of the programmer and reduce the cost of programming. They also compare the cost of programming at the machine level, assembler level, and with high level languages against the time involved to program at the different levels. Also compared are the execution times for the different levels of programming.

Software aids such as assemblers, operating systems, program debugging aids, high level languages, and text editors are discussed and examples given.

A section on microcomputer interfacing places primary emphasis on the 6502. Some of the design examples are a function generator, a keyboard interface, a Seiko printer interface, and analog-to-digital conversion. The examples give circuits and programs for the 6502. This section also includes information on RS232C, Teletype, and TTL characteristics and standards.

The last chapters of the book are to be used as a lab manual for the KIM-1 microcomputer, which features the 6502 microprocessor. They describe the hardware and software of the KIM-1 and show how to program it through the keyboard. The information is given in a detailed, step-to-step form.☐

AN INTRODUCTION TO MICROCOMPUTERS. Vol. 2
Some Real Microprocessors
Osborne & Associates. $30
Review by Alan R. Miller, Software Editor

Osborne & Associates offers a series of four volumes entitled "An Introduction to Microcomputers." It starts with elementary concepts of microprocessors in general, then progresses to the details of specific hardware. Volume 2 looks more like a collection of specification sheets from a semiconductor manufacturer rather than a textbook on microcomputers.

The 4-bit microprocessors of the TMS 1000 type are described first. These are followed by the 8-bit CPUs such as the Fairchild F8, the National SC/MP, the Intel 8080 and 8085, and the Zilog Z80. Finally, the 16-bit processors such as the National PACE, the Texas Instruments 9900, the Data General PACE, and the long-awaited Intel 8086 are described.

Fifty to 60 pages are devoted to each chip. The extensive section on the Intel 8086 was very interesting, since it was the first detailed description this reviewer has seen for this device. The section on the Z80 begins with a comprehensive comparison with the 8080 (and the 6800 during the discussion of address modes). The section will be particularly useful to those who are upgrading to a Z80 from an 8080.

Overall, this volume is a very complete collection of data for all of the current microprocessors. The looseleaf style insures that it will not become out of date.☐

BASIC FOR HOME COMPUTERS — A Self-Teaching Guide
By Bob Albrecht, Leroy Finkel, Jerald Brown. $5.95
Review by Kelly A. Lee

As a relative newcomer to microcomputers I found this a most concise and informative book. It starts with the basics, and gives a small glimpse of the various types of personal computing machinery before jumping head first into programming.

The authors start by familiarizing the reader with the keyboard and various common BASIC phrases and operations used on the computer. The chapters then proceed through assignment and logical statements, the storing of programs, and the use of read statements, and for-next loops. After this, the book enters the realm of single and double subscripted variables, string variables, functions and subroutines.

The chapters are divided into frames with key questions after each frame. A chapter self-test follows with answers and reference numbers to the frames involved. A final self-test, an appendix of BASIC functions and an ASCII character code table follow a well-planned sequence of BASIC programming skills.

As a reference, this book is a must for the student's and businessman's library alike. It is an excellent teaching guide and and worth the investment for the BASIC programmer.☐

APL for the Z-80 Vanguard's CP/M Version

Review by Alan R. Miller, Software Editor

INTRODUCTION

APL is an acronym for A Programming Language, a computer language that is especially suitable for general data processing involving both character and numeric arrays. Useful applications range from pure mathematical analysis to the processing of business records. APL is usually implemented as an interpretive language as is BASIC. Thus the user's source program and data reside in memory along with the APL processor. An immediate answer can be obtained simply by typing an expression such as:

```
      7 + 4      <the user types this>
11               <APL responds with this>
```

(APL moves in from left margin when waiting for input.)

The user can also write functions as in BASIC or FORTRAN:

```
      SQRT 4
2
```

A special terminal is usually necessary for APL since many of the APL symbols are not found on the usual computer terminal. Table 1 lists the APL character set along with the corresponding hexadecimal code, and the standard ASCII characters for the same code. Notice that the APL Roman letters which are used for symbols correspond to the ASCII lowercase letters.

Table 1.

APL		ASCII	APL		ASCII	APL		ASCII
·	20		¯	40	@	◊	60	`
¨	21	!	α	41	A	A	61	a
)	22	"	⊥	42	B	B	62	b
<	23	#	∩	43	C	C	63	c
≤	24	$	⌊	44	D	D	64	d
=	25	%	ε	45	E	E	65	e
>	26	&	_	46	F	F	66	f
]	27	'	∇	47	G	G	67	g
∨	28	(	∆	48	H	H	68	h
∧	29	)	⍳	49	I	I	69	i
≠	2A	*	∘	4A	J	J	6A	j
÷	2B	+	'	4B	K	K	6B	k
,	2C	,	⎕	4C	L	L	6C	l
+	2D	-	|	4D	M	M	6D	m
.	2E	.	⊤	4E	N	N	6E	n
/	2F	/	○	4F	O	O	6F	o
0	30	0	*	50	P	P	70	p
1	31	1	?	51	Q	Q	71	q
2	32	2	⍴	52	R	R	72	r
3	33	3	⌈	53	S	S	73	s
4	34	4	∼	54	T	T	74	t
5	35	5	↓	55	U	U	75	u
6	36	6	∪	56	V	V	76	v
7	37	7	⍵	57	W	W	77	w
8	38	8	⊃	58	X	X	78	x
9	39	9	↑	59	Y	Y	79	y
(	3A	:	⊂	5A	Z	Z	7A	z
[	3B	;	←	5B	[	{	7B	{
;	3C	<	⊢	5C	\	⊣	7C	|
×	3D	=	→	5D	]	}	7D	}
:	3E	>	≥	5E	^	$	7E	~
\	3F	?	-	5F	_			

```
The APL character set
¨)<≤=>]∨∧≠÷,+./0123456789([;×:
\¯α⊥∩⌊ε_∇∆⍳∘'⎕|⊤○*?⍴⌈∼↓∪⍵⊃↑⊂←⊢→≥
-◊ABCDEFGHIJKLMNOPQRSTUVWXYZ{⊣}$
```

Some of the APL characters are formed by typing one character, backspacing with a Control-H, then overstriking a second character (the order of entering the two characters is immaterial). For example, the logarithm is obtained by overstriking the large O with the asterisk. The APL digits 0 through 9 are the same as the ASCII digits. The APL symbols:

+ − * ( ) [ ] ! ? : ; \ < > ^

look like ASCII characters, but are not on the usual keys. In fact, the exclamation point is formed by overstriking the decimal point with the apostrophe.

The locations of some of the APL characters are easy to remember. The Greek rho is on the R, the iota is on the I, the epsilon is on the E, the large O is on the O, the question mark is on the Q, the alpha is on the a, the w-shaped omega is on the W, and the symbol for power, the *, is on the P. A frequently used character, the box, is used to LOOK at the results. It is on the L key.

The great power of APL derives from the large number of intrinsic functions. For example, the command Iota 10 will generate a one-dimensional array (a vector) containing the numbers 1 through 10.

```
      ⍳ 10
1 2 3 4 5 6 7 8 9 10
```

NO HIERARCHY

The ordinary minus sign indicates subtraction, while a raised minus sign, usually on the same key as the number 2, is used to designate a negative number. This distinction between subtraction and negation is necessary because of the way that expressions are evaluated in APL. In BASIC and FORTRAN, there is a hierarchy of operations. For these languages, exponentiation has a higher precedence than multiplication and division. But multiplication and division have a greater precedence than addition and subtraction. This means that the expression:

A = 4 * 10 − 3 ** 2 (FORTRAN)
A = 4 * 10 − 3 ^ 2 (BASIC)

will evaluate to 22 in FORTRAN and BASIC because of the implied parentheses:

A = (4 * 10) − ((3 ** 2) * 2)

APL on the other hand has no hierarchy; all functions are

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treated equally. Although parentheses can be used in APL as in other computer languages to alter the usual interpretation. Each APL expression is evaluated from RIGHT to LEFT. Thus the APL expression that looks like those above:

```
A ← 4 x 10 - 3 * 2 x 2
```

produces a value of −284. The implied parentheses are:

```
A ← 4 x (10 - (3 * ( x 2)))
```

Explicit parentheses can be added to give a result of 22:

```
A ← (4 x 10) - (3 * 2) x 2
```

For many expressions, no parentheses are needed if the terms are placed in the proper order. For example, the polynomial:

Z = 1 + 2*Y*Y + 3*Y*Y*Y + 4*Y*Y*Y*Y + 5*Y*Y*Y*Y*Y

can be efficiently computed by nesting the terms. The expression in BASIC or FORTRAN is:

Z = 1 + Y*(2 + Y*(3 + Y*(4 + Y*5)))

But no parentheses are needed in APL:

```
Z ← 1 + Y x 2 + Y x 3 +
    Y x 4 + Y x 5
```

ARRAYS

In FORTRAN and BASIC, the length and rank of arrays are specifically declared in a dimension statement. (Arrays of rank 1 have one dimension and are termed vectors. Those of rank 2 have 2 dimensions and are called matrices.) In APL, arrays are defined like a simple variable (a scalar) when they are needed. Their rank can be changed at any time. For example, a vector can be defined simply by listing the elements (which might represent the hours worked by each employee):

```
DAY1 ← 8 8 8 6.5 7 9 8
```

The sum of the elements (total number of hours) is obtained by plus compression:

```
SUM ← +/ DAY1
```

The number of elements (employees) is found with the rho operator:

```
NHOURS ← ⍴ DAY1
```

A two-dimensional matrix could be used to represent the monthly employment hours, each column referring to a day and each row referring to an employee. The daily employment vectors can be combined by using the concatenation operator, a comma:

```
MONTH ← DAY1, DAY2, DAY3
```

The monthly vector can be reshaped into a two-dimensional matrix by using the rho symbol:

```
MONTH ← NHOURS NEMPLOY ⍴ MONTH
```

This will produce a matrix of NHOURS columns and NEMPLOY rows. If necessary, MONTH could be reshaped to a one-dimensional vector with ravel symbol:

```
MONTH ← ,MONTH
```

Most APL functions can have either one argument (a monadic function) or two arguments (a dyadic function), so that there are nearly twice as many functions as symbols. The argument always appears to the right of the monadic symbol. For a dyadic function, one argument is placed on the left of the symbol and the other is placed on the right. In the above examples, the function rho was used monadically to find the length (shape) of its one argument, but was used dyadically to reshape the right argument according to the left argument. The comma was used monadically to ravel a matrix into a vector, and also used dyadically to concatenate its two arguments.

An array of data can be changed as easily as a single variable. If the vector named PRICES contains the sale price of all items in inventory, a given percent increase can be effected by the expression:

```
PRICES ← PRICES x 1.05
```

Each element of the vector PRICES will now be 5 percent larger.

MATRIX INVERSION

The domino or divide-quad symbol formed by overstriking the box with the divide symbol, can be used to invert a matrix. It can be used to find the solution to a set of linear equations such as:

$X + Y + Z = 6$
$X + Y - Z = 0$
$2X + Y - Z = 1$

The APL variables A and B are first defined:

```
A ← 3 3 ⍴ 1 1 1 1 1 ¯1 2 1 ¯1
B ← 6 0 1
```

where A is the matrix of coefficients to X, Y, and Z, and B is the constant vector. The solution, X = 1, Y = 2, Z = 3 is

found with the dyadic domino expression:

B ⌹ A

Future trends in sales can be projected with the domino and the outer product operation, by performing a least-squares curve fit.

The useful domino function is not included as an intrinsic function in the Vanguard version, but is supplied as two user-defined functions. One is named DDOMINO (dyadic domino), and the other is called MDOMINO (monadic domino). Because DDOMINO is relatively slow (taking nearly 30 seconds to solve three equations), the user function SOLV is included (see Listing 1). Function SOLVE will find the solution to two or three simultaneous equations in about 4 seconds. The command is:

```
      B SOLVE A
 1 2 3
```

For more information about APL see "APL, An Interactive Approach," by L. Gilmen, Wiley. This book is an excellent combination of a basic text and a workbook of many useful problems.

SYSTEM COMMANDS

The Vanguard version of APL contains 20 system commands. These are distinguished from variables and functions by the leading right parenthesis.

)OFF	terminate the session
)ERASE name(s)	delete workspace name(s)
)WSID	print workspace name
)WSID name	rename workspace
)CLEAR	delete all workspace names
)SAVE	save workspace on disk
)LOAD name	fetch workspace from disk
)DROP name	delete name from disk
)LIB	list saved workspace names
)CSAVE name	save user function on disk
)COPY name	fetch function from disk
)CDROP name	delete name from disk
)CLIB	list saved functions
)WIDTH n	set output width
)DIGITS n	set print precision
)SYMBOLS n	set symbol table size
)SYMBOLS 0	find symbol table size
)ORIGIN n	set index origin (0 or 1)
)FNS	list function names
)VARS	list variable names
)SI	check for suspended function

When APLZ80 is first loaded, the user's workspace is cleared and given the name CLEARWS. The user is next asked to enter a 6-digit date as mmddyy. The response is coded into any workspace that is saved during the session, and is also available as a system variable. The value of the month must be between 1 and 12 and the value for the day 1 to 31. If there is a saved workspace named CONTINUE.AWS, it is automatically loaded at this time.

If a new workspace is desired, the symbol table size should be enlarged at this time with the command:

```
)SYMBOLS 103
```

If the symbol table has to be enlarged later, the task is rather cumbersome. All functions must be saved onto the disk with repeated)CSAVE commands. The workspace is cleared and the symbol table is enlarged. Then the workspace is renamed back to its original name, and all functions are recopied into the workspace:

```
)CSAVE NAME1
)CSAVE NAME2
)CSAVE NAME 3
   etc
)CLEAR
)SYMBOLS 103
)WSID NAME
)COPY NAME 1
)COPY NAME2
)COPY NAME3
   etc
```

This task can be simplified by use of the system functions Quad K and Quad N.

The NAME of the workspace should be changed to something meaningful before it is saved onto the disk:

```
)WSID SALES          <rename workspace>
)SAVE                <save workspace>
```

During a work session, backup copies should be made regularly by renaming the workspace:

```
)WSID SALES2
)SAVE
 . . .
 . . .
)WSID SALES3
)SAVE
 . . .
 . . .
```

The LIB command can be used to list the saved workspaces. Earlier versions can be deleted with the drop command:

```
        )LIB            <list saved workspace>
SALES
SALES2
SALES3
        )DROP SALES     <delete SALES>
        )LIB            <get new list>
SALES2
SALES3
```

THE LOWER-CASE FILENAMES

When a workspace or function (copy object) is saved as a disk file with the)SAVE or)CSAVE command, APLZ80 writes the primary filename in lower-case letters. The file extension is AWS (for APL workspace) or ACO (for APL copy object) written in upper-case letters. This format may cause some difficulty in file handling at the systems level. CP/M converts all lower-case console input to upper case. Thus PIP, SID, and DDT cannot be used to make backup copies of individual APLZ80 files. APLZ80 can be altered so that disk files will always be written and read in upper-case letters. The patch areas are given in the user manual. This change allows APL files to be handled with CP/M in the usual way.

Backup copies of the workspace can also be made with APLZ80 if there is more than one disk. In this case, the default drive is changed with the system variable Quad U. If only one disk drive is available, or in any case when a diskette is to be changed, a CP/M warm start can be effected by defining the system variable Quad U to be zero.

SYSTEM VARIABLES

There are several system variables that can be used like ordinary variables. Some are duplications of the system commands. These system variables all start with the quad character.

⎕A	AVAILABLE WORKSPACE
⎕O	INDEX ORIGIN, 0 OR 1
⎕P	PRINT PRECISION
⎕W	PRINT WIDTH
⎕H	LINE PRINTER TOGGLE
⎕U	SWITCH DISK DRIVES
⎕D	CURRENT DATE

The statement:

```
⎕H ← 1        (TURN ON LIST)
```

will turn on the list switch. Now all output will be sent to the list device as well as to the console. This variable can be reset by setting it back to zero:

```
⎕H ← 0    (TURN OFF LIST)
```

System variables can also be used in user-written functions. The initial value of the variable can be saved at the beginning of the function, then redefined for use in the function. The variable is reset to its original value at the end of the function:

```
S ← ⎕O    (SAVE ORIGIN)
⎕O ← 0    (CHANGE TO ZERO)
 .  .  .
 .  .  .
⎕O ← S    (RESET ORIGIN)
```

USER-DEFINED FUNCTIONS

The user can write functions that have no arguments (biladic), one argument (monadic), or two arguments (dyadic). User functions can duplicate the built-in functions or can be more complicated. User-written functions called PI, SIN, SQRT, LOG, EXP, for example, are easier to use (especially if the console keyboard doesn't have the APL character set).

User functions are defined with the del operator (on the G key).

```
∇R ← SQRT Z
```

APL responds with the next available line number (which is line ten for the first line). Then the function body is typed in. The first line or two should be devoted to comments, describing the purpose of the function and its usage. The APL lamp character is placed at the beginning of each comment line. It is formed by overstriking the small o (null) on the J key with the cap on the C (comment) key.

FUNCTION EDITING

After the end of a line is signaled with a carriage return, APL prints the next line number embedded in brackets. APLZ80 increments the line numbers by 10. If a line needs to be inserted between two existing lines, an intermediate line number is entered at the beginning of the line, right after the line number printed by APL:

[50] [15] <expression> <carriage return>

This line will then be physically placed between line 10 and 20. A line can be deleted by typing the line number, followed by just a carriage return:

[50] — <carriage return>

An entire line can be replaced by starting the line with the line number. The function header is not numbered, but it can be replaced by giving a line number of zero:

```
[50] [0] R ← SQR Z
```

The function name can also be changed in this way. The entire function can be listed with the box operator:

```
[50] [⎕]
```

LINE EDITING

APLZ80 is supplied with a line editor that is useful for altering longer lines. (For shorter lines, it is easier to simply

retype the entire line.) The command:

```
[50] [20 ⎕ 6]
```

will edit line 20. The entire line is printed, then the cursor is moved 6 spaces to the right. If the cursor is not in the desired location, it can be moved to the right with the space bar or to the left with the backspace (Control-H).

The forward slash is placed under each character to be deleted. A back slash is placed under each character that is to have a string of characters inserted ahead of it. The space bar and backspace can be used to position the cursor for several deletions or insertions. A carriage return completes this first part of the editing.

The line is then automatically reprinted without the deleted characters. The cursor stops at the first insert location (if any). The user can now enter the desired text. A Control-D completes this insertion and moves the cursor to the next insert location. A final Control-D completes the line edit.

SOME USEFUL FUNCTIONS

Listing 1 gives some common user functions. The function PI is easier to use than the corresponding APL expression of a large O followed by a one. The square root function SQRT will usually obviate the need for one set of parentheses:

((Y * 2) + Z * 2) * .5<straight APL>
SQRT (Y * 2) + Z * 2 <user function>

APL requires that angles be expressed in radians rather than in degrees (as do FORTRAN and BASIC). The trig functions can perform this automatic conversion of the argument between radians and degrees:

```
1 ○ 45 × PI ÷ 180 <STRAIGHT APL>
SIN 45            <USER FUNCTION>
```

The arctangent function ATAN is more precise than the one supplied with APLZ80. Both are based on an infinite series expansion around zero degrees. The original version starts to fail near 45 degrees and is badly off by 85 degrees. Two more terms were added to the series to improve the precision. Also a conditional branch was added so that angles above 45 degrees are converted to the complementary angle below 45 degrees. Thus the greatest error now occurs at 45 degrees.

BRANCHING

Branching is performed in APL functions with the right arrow. The expression:

```
→ 0    <ZERO>
```

will terminate the function with a normal return to the calling program. Such a branch is not necessary for the last line of the function.

Branching to a regular line will occur if the argument after the right arrow evaluates to a valid line number. Thus:

```
→ 30
```

will cause an unconditional branch to line 30. However, it is better programming practice to use a label for the argument:

```
[30] → ERROR
  .  .  .
  .  .  .
[90] ERROR:    <EXPRESSION>
```

Then if the line numbers change because of line deletion or insertion, the function will still operate correctly.

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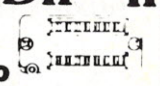

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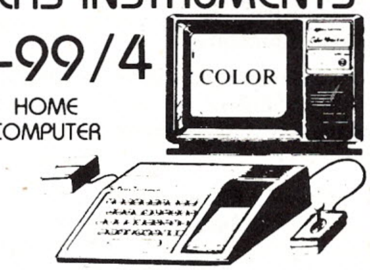

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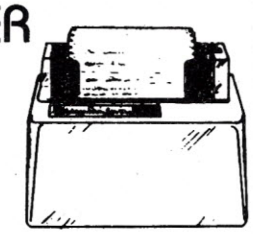

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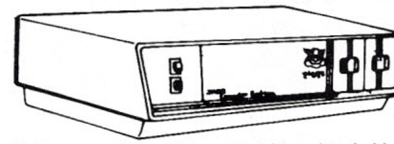

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CONDITIONAL BRANCHING

Conditional branching is obtained with a logical expression and a slash preceding the label:

```
[20] → (B > 1) / LARGE
 . . .
 . . .
[80] LARGE> <EXPRESSION>
```

as in the arctangent function. In this case the logical expression B > 1 has a value of 1 if true and the whole line then has the value equal to the line number of the label LARGE (80 in this case). On the other hand, if the logical expression B > 1 is false, the entire line has a null value. In this case, the instruction immediately following the conditional branch (line 30) is executed next.

Re-entrant code is allowed in APL functions. Notice that for angles greater than 45 degrees in the function ATAN, the argument is reciprocated, then the function calls itself with this complementary argument. For this second call, however, the argument is less than unity, so the conditional branch at line 30 is false. Lines 30 through 70 are then executed.

BRANCHING WITH AN IF-THEN CONSTRUCTION

By including in the workspace the user-defined functions IF and THEN, conditional branches in APL can be significantly easier to comprehend. Listing 1 shows that the IF function is actually a do-nothing function, it simply passes along its argument. The THEN function has the task of generating the value of the label if the preceding logical expression is true, or producing a null value if the logical expression is false.

Thus, line 20 of the ATAN program could be replaced with:

```
[20] → IF (B > 1) THEN LARGE
```

Examples of the IF-THEN construction are given in the functions DET and SOLV of Listing 1. If a function is programmed to locate an input error (e.g., line 70 of DET), an error message can be printed. But it is also necessary to set the result (R in this case) to a null value. One way of doing this is with the expression zero rho zero as in line 80 of DET.

SUSPENDED FUNCTIONS

If a user function containing a syntax error is called, the function remains suspended at the point of error. This suspension must be cleared before saving the workspace or any of its functions. Attempting to save a workspace or function with a suspended function will produce the error message:

NOT WITH SI

To determine if there is a suspended function, give the command:

)SI

If nothing is printed in response, everything is all right. Otherwise, enter a right arrow and carriage return for each line that is printed after the)SI command. Give a final)SI command to insure that all is clear.

SORTING DATA

Data can be sorted very easily in APL. The grade-up function, formed by overstriking the delta symbol (on the H key) with the residue (on the M key) is used to sort a vector in increasing order. Data can be sorted in reverse order by using the grade-down function. It is formed by overstriking the del symbol (on the G key) with the residue.

```
      DAT1 [⍋ DAT1]
6.5 7 8 8 8 8 9
      DAT1 [⍒ DAT1]
9 8 8 8 8 7 6.5
```

A function called SORT is given in Listing 1 that makes sorting even easier.

```
      SORT  DAY1
6.5 7 8 8 8 8 9
```

FORMATTING THE OUTPUT

APL output can be formatted as in BASIC and FORTRAN. The format function is formed by overstriking the encode character (on the n key) with the null (on the J key). The left argument of the format function is a vector of length two. The first number gives the field width and the second number gives the number of places past the decimal point. For example, data is printed with a field width of 5 and with one digit past the decimal point, even when that digit is a zero, by using the expression:

```
      5 1 ⍕ DAY1
8.0  8.0  8.0  6.5  7.0  9.0  8.0
```

MAKING DO WITH A NON-APL TERMINAL

The APL characters are available as a set of stick-on labels that can be affixed to the front of the console keys. This only solves half of the problem, however, since the console will still printout the original characters. One solution is to alter the Output-Translate Table in APLZ80.

Listing 2 gives a hexadecimal and ASCII dump of the altered table for the CP/M serial version. The listing shown will substitute the ASCII equivalent for the APL value wherever possible. For example, the APL right parenthesis is an ASCII up-arrow. The altered table substitutes the ASCII right parenthesis in this case. Of course, it would be more convenient to have a DECwriter with an APL character set.

SYSTEM FUNCTIONS

User-written functions, such as ATAN can be listed with the DEL command:

```
∇ ATAN [⎕] ∇
```

But this is an inconvenient method for listing all of the functions in the workspace. APL/Z80 contains a pair of system functions that can make this task easier. Quad N can be used to generate a character matrix of the function names, and Quad K can be used to list each function.

The user function called LIST, given in Listing 1, performs this task. Simply give the command LIST and all functions will be listed. In fact, Listing 1 was actually generated with the function LIST.

CONCLUSION

APL is such a powerful language, that those who try a little of it usually get hooked. Over the past ten years, this reviewer has taught both FORTRAN and BASIC to college students. They have typically embraced these lessons with less than overwhelming enthusiasm. This year, for the first time, I have introduced my students to APL first. The response has been astonishing. They love it.

Because APL is an interpretive language, the user gets an immediate response: either an answer or an error message. The large set of built-in APL functions allows problems to be solved in relatively few steps, and with very little programming time. The beginner gets answers immediately.

I began this review with the feeling that APL will never replace BASIC or FORTRAN, but now I am not so sure. The Vanguard APL can do most anything that our DEC-20 APL can do, and often do it must faster.

We are going to be seeing more APL programming in the future. Microsoft has announced a forthcoming 8080 version that can be used with an ordinary computer terminal. Vanguard's APLZ80 is a powerful addition to the APL software library, although it cannot be run on an 8080.□

LISTING 1

```
      ∇R←IF COND
[10] R←COND
      ∇

      ∇Z←ATAN B;Y;Y2
[10] Y←|B
[20] →(Y>1)/LARGE
[30] Y2←Y×Y
[40] Z←16×Y2÷9+25×Y2÷11+36×Y2÷13
[50] Z←Y÷1+Y2÷3+4×Y2÷5+9×Y2÷7+Z
[60] Z←Z×(180÷○1)×¯1*B<0
[70] →0
[80] LARGE:Z←(90-|ATAN÷B)×¯1*B<0
      ∇

      ∇R←DET A
[10] ⍝ 3 BY 3 DETERMINANT
[20] →IF((∧/3 3≠⍴A)∨2≠⍴⍴A)THEN ERROR
[30] R←A[1;1]×(A[2;2]×A[3;3])-A[3;2]×A[2;3]
[40] R←R+A[1;2]×(A[3;1]×A[2;3])-A[2;1]×A[3;3]
[50] R←R+A[1;3]×(A[2;1]×A[3;2])-A[3;1]×A[2;2]
[60] →0
[70] ERROR:'DET ERROR'
[80] R←0⍴0
      ∇

      ∇R←COS Z
[10] R←2○Z×○÷180
      ∇

      ∇R←EXP Z
[10] R←*Z
      ∇

      ∇R←COND THEN LABEL
[10] LABEL←,LABEL
[20] →(1≠⍴LABEL)/ERROR
[30] →(1≠⍴COND)/ERROR
[40] →(~COND∊0 1)/ERROR
[50] →(0≠COND)/TRUE
[60] ⍝ COND FALSE
[70] R←0⍴0
[80] →0
[90] ⍝ COND TRUE
```

```
      ∇R←PI
[10] R←○1
      ∇

      ∇R←SQRT Z
[10] R←Z*0.5
      ∇

      ∇R←SIN Z
[10] R←1○Z×○÷180
      ∇

      ∇R←Y SOLV A;A1;A2;A3;RA
[10] ⍝
[20] ⍝ SOLVE 2 OR 3 SIMUL EQUATIONS
[30] ⍝ FUNCTIONS TR AND DET REQUIRED
[40] ⍝
[50] RA←⍴A
[60] A1←⍴Y
[70] A2←2=⍴RA
[80] A3←1=⍴A1
[90] ⍝
[100] ⍝ CHECK FOR PROPER RANK
[110] ⍝
[120] →IF((∧/3 3=RA)∧A2∧(3=A1)∧A3)THEN THREE
[130] →IF((∧/2 2=RA)∧A2∧(2=A1)∧A3)THEN TWO
[140] ⍝
[150] ' SOLV ERROR'
[160] R←0⍴0
[170] →0
[180] ⍝ THREE EQUATIONS
[190] ⍝
[200] THREE:RA←,TR A
[210] A1←DET 3 3⍴(Y,3↓RA)
[220] A2←DET 3 3⍴(3↑RA),Y,6↓RA
[230] A3←DET 3 3⍴(6↑RA),Y
[240] R←(A1,A2,A3)÷DET A
[250] →0
[260] ⍝ TWO EQUATIONS
[270] ⍝
[280] TWO:A1←(Y[1]×A[2;2])-Y[2]×A[1;2]
[290] A2←(A[1;1]×Y[2])-A[2;1]×Y[1]
[300] R←(A1,A2)÷(A[1;1]×A[2;2])-A[2;1]×A[1;2]
      ∇
```

```
[100] TRUE:R←LABEL
[110] →0
[120] ERROR:'ERROR IN THEN'
[130] R←0⍴0
      ∇


      ∇R←Y LINFIT X;SUMX;SUMY;SUMX2;SUMXY;N;SRS;SUMY2;DEN
[10] ⍝ LEAST SQUARES FIT TO Y VS X
[20] ⍝ YCALC, RESID, COR ARE GLOBAL
[30] ⍝
[40] N←⍴X
[50] DEN←⍴Y
[60] →IF((1≠⍴DEN)∨1≠⍴N)THEN ERROR
[70] →IF(DEN≠N)THEN ERROR
[80] SUMX←+/X
[90] SUMX2←+/X×X
[100] SUMY←+/Y
[110] SUMY2←+/Y×Y
[120] SUMXY←+/X×Y
[130] DEN←(N×SUMX2)-SUMX*2
[140] R←(SUMY×SUMX2)-SUMX×SUMXY
[150] R←(R,(SUMXY×N)-SUMX×SUMY)÷DEN
[160] YCALC←R[1]+R[2]×X
[170] RESID←Y-YCALC
[180] SRS←+/RESID*2
[190] COR←SQRT 1-SRS÷SUMY2-SUMY×SUMY÷N
[200] →0
[210] ERROR:'LINFIT ERROR'
[220] R←0⍴0
      ∇

      ∇R←LOG10 Z
[10] R←10⍟Z
      ∇

      ∇R←RND
[10] ⍝ RANDOM NUMBER 0 TO 100
[20] R←0.01×?100
      ∇

      ∇R←LOG Z
[10] R←⍟Z
      ∇

      ∇R←MEAN Z
[10] R←+/Z÷⍴,Z
      ∇

      ∇R←TAN Z
[10] R←3○Z×○÷180
      ∇

      ∇R←TR X;RX;I;O
[10] RX←⍴R←X
[20] O←⎕O
[30] →(1≥⍴⍴X)/I←0
[40] ⎕O←0
[50] R←⍳RX[0]
[60] LP:→((⍴RX)≠⍴⍴R←(⍳RX[I←I+1])∘.+RX[I+1]×R)/LP
[70] R←(⍴R)⍴(,X)[,R]
[80] ⎕O←O
      ∇

      ∇LIST;I;I14;I15;N
[10] ⍝ LIST ALL FUNCTIONS
[20] N←1↑⍴⎕N 0
[30] I←0
[40] I15←0
[50] LOOP:I←I+1
[60] I14←I15
[70] I15←I14+15
[80] ⎕K I14↓I15↑,⎕N 0
[90] →(I<N)/LOOP
      ∇

      ∇R←SORT Z
[10] R←Z[⍋Z]
      ∇
```

LISTING 2

```
0F00: 20 20 20 20 20 20 20 20 08 20 0A 20 20 0D 20 20        .  .   .
0F10: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
0F20: 20 21 2D 23 24 25 5E 26 2A 28 2D 28 2C 23 2E 2F  !-#$%^&*(-(,#./
0F30: 30 31 32 33 34 35 36 37 38 39 2B 5B 3B 25 3A 5C 0123456789+[;%:\
0F40: 20 41 42 43 44 45 46 47 48 49 4A 27 4C 4D 4E 4F  ABCDEFGHIJ'LMNO
0F50: 2A 51 52 53 54 55 56 57 58 59 5A 5D 20 20 5F 20 *QRSTUVWXYZ]  _
0F60: 20 61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F  abcdefghijklmno
0F70: 70 71 72 73 74 75 76 77 78 79 7A 29 60 5E 5D 24 pqrstuvwxyz)`^]$
```

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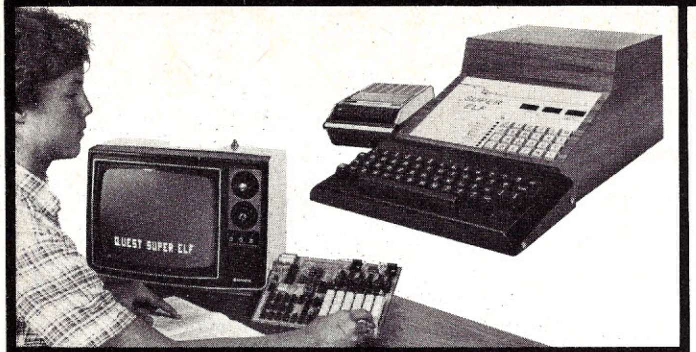

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The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step.** Large, on board displays provide output and optional **high and low address.** There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** Expansion Cabinet with room for 4 S-100 boards **$41.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also come completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic Cassette **$10.00,** on ROM **$38.00,** original Elf kit board **$14.95.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface.** Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf.** The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A IK Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatible cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports with full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. A Godbout 8K RAM board is available for $135.00. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $12.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

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CD4051	1.13
CD4060	1.42
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CD4069	.40
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18	.27	36	.58
20	.29	40	.57

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14 pin .25
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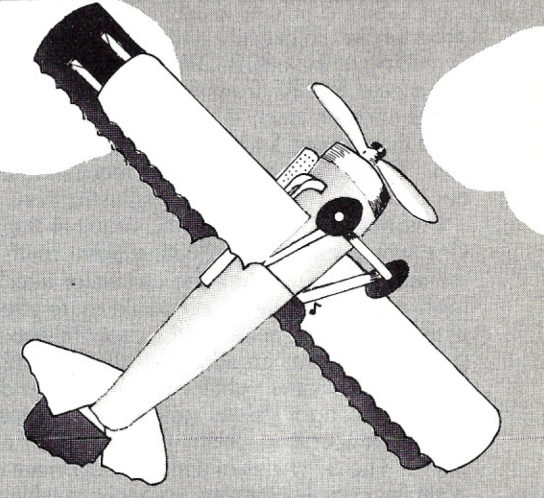
SWTPC's New PILOT



Review by Jim Schreier, Associate Editor

PILOT, a sophisticated microcomputer language, may soon outdate text books and correspondence schools. Entire college courses could fit on a set of minifloppy disks. All of this is possible with the Southwest Technical Products Corporation (SWTPC) PILOT v 1.0.

What is PILOT like? What software is available? What is the programming like? These are interesting questions. Little is known about PILOT. Only a few articles have been published in the last two years.

PILOT has been bred for computer assisted instruction (CAI) because it allows for different answers. If a BASIC program asks the color of a tree, for example, the resulting response would have to match the required answer, letter for letter, space for space. BASIC would have difficulty accepting answers like "GReen", "brownish", "YEL Low", or even "DEAD". But PILOT understands and responds to a variety of such answers. Because of this flexibility, it can interact with a student's individual tutoring, drills, tests or laboratory simulations.

If BASIC is specific, PILOT is general. This is not to say that PILOT lacks refinements. The logic flow of PILOT can be as ingenious as any BASIC program. BASIC is a mathematical/text language. PILOT is more like a text editor with mathematical appendages.

The similarities and differences of the two languages may be noted by reviewing the program excerpts (Figure 1). Both programs achieve the same objective. Although the subject matter, "Arizona History" may be expanded in either language, PILOT is simpler programming and takes less RAM.

A few differences may be noted. BASIC follows line numbers like railroad tracks. It gets where it is going by following a direct path. PILOT travels a programming freeway with any number of exits and entrances. BASIC requires exact spelling of "PRINT", "INPUT", "GOSUB", etc. functions. PILOT uses a single letter that may be modified with one additional letter. BASIC remains fussy about quotation marks and semicolon manipulation. PILOT simply eliminates them. BASIC's code is built using the interpreter. PILOT's code is created through a host program.

BASIC executes from RAM reserved beyond the interpreter. PILOT uses a minimum of RAM for scratch pad storage. PILOT's programs execute directly from the minifloppy disk. It is possible to run a 75K PILOT program with 16K RAM using 8K for PILOT, 4K for the FLEX™ DOS and 4K RAM for the scratch pad. It is interesting to note that SWTPC disk BASIC v 3.0 uses 9052 bytes while PILOT gets by with a modest 7564 bytes. At least, so it seems. PILOT's space secret will be revealed shortly.

Both languages have a number of similarities. For example, both support dimensioning, variables, string manipulation, jumps, relational operators and mathematic functions. Although COMMON PILOT supports random access disk files, the SWTPC version does not. The manual explains that ". . .at the time of this writing FLEX did not support random access disk files. . .(so the necessary) op codes in PILOT are not implemented in version 1. This should not pose any hardships since random disk files are not often required for CAI courses."

It appears, then, that SWTPC PILOT has had an interesting genealogy.

At first, PILOT was started at the San Francisco Medical Center as a simple CAI language. This was called "Core PILOT" or "PILOT 73." It supported eight operation codes, or op codes for short. With the advent of microcomputers in the mid-1970s, new PILOT dialects were developed by several institutions, including Western Washington University. These results were "extended" versions of PILOT. The authors, Larry Kheriaty and George Gerhold, of MICROPI, 2445 N. Nugent, Lummi Island, WA 98262, have extracted the key features of extended PILOT into a "standard" microcomputer based language called COMMON PILOT. Having a workable language, tried and true, ready for many microcomputer systems is one way to create a standard. A standard microcomputer language has much potential. In addition, MICROPI has single-user 8080/Z-80 and Pascal versions of COMMON PILOT available.

The latest genealogical step is SWTPC's adaption of COMMON PILOT to its multi-user PILOT version 1.0. SWTPC's PILOT is self-contained, executing in one of two formats. This is unique. Usually program versatility requires a block and tackle to get it up-and-running. In this version the user has the choice of a single station format or up to four stations for PILOT time-sharing.

The introductory manual materials, written by SWTPC, lead one to believe a block and tackle would be necessary, as numerous address alterations are outlined. It was discovered, contrary to the manual, that the suggested address alterations were not necessary. A serial board is placed in port 1 and the SWTPC MP-N calculator interface is placed in port 7. The PILOT disk then executes, using the regular FLEX DOS.

PILOT will not operate without the prerequisite port hardware. It was assumed a sample PILOT program could be reviewed without the MP-N calculator interface. Instead the

program would execute and the disk would immediately die. A reading of the 6800 CPU revealed PILOT was looping into address $11BF from $1058. Every third execution provided another loop. A check of the PILOT memory map gave the answer. $11BF was waiting for the calculator interface. The sample program was requesting a user input number between 1 and 5 as its first instruction.

It is not clear why SWTPC requires the MP-N interface. One would expect that floating point math be contained in the language. Although the calculator interface saves RAM, most microcomputer users would more effectively make use of their dollars by applying the cost of the expensive interface ($46.50) towards an additional 4K RAM ($75).

The $25 price is right for the software and documentation. SWTPC's bright yellow notebook contains the minifloppy FLEX disk operating system, utilities, PILOT and 2 sample programs. The 67 pages of documentation are excellent, but, as in similar complex software packages, a table of contents is not enough. A subject/error index is necessary; or even a concordance would be helpful in order to save programming time.

The software works without a hitch. The SWTBUG™ monitor loads the disk boot and the FLEX DOS, after which a display at the terminal welcomes the user to PILOT. PILOT is loaded by entering "PILOT" at the terminal. The program responds with "UNIT=". The user enters the disk file drive, 0-3; after which "FILE=" is displayed. The second request is for the name of the program.

At this point a strange thing happens. It can be called SWTBUG ghost effect. All FLEX TTYSET.CMD pre-set variables are lost. (The TTYSET command allows setting terminal controls, line length, width, duplex, etc.). With the duplex altered, the terminal develops a case of double vision. This can be manually adjusted, but remains a special problem of SWTBUG.

```
PR: USGE
D: G2$(4)
D: J3$(1)
C: G = 0
C: Y = 1
C: G2$ = CHR(26)
C: G2$ = G2$!!G2$!!G2$
C: J3$ = CHR(2)
C: G2$ = G2$!!J3$
T:
T: $G2$        ARIZONA HISTORICAL SURVEY
T:      A SAMPLE PROGRAM - COMMON PILOT
T:
C: G = 1
T: QUESTION #G
T:
*TERR T: IN 1860 ARIZONA WAS PART OF WHICH TERRITORY?
A:
MS: NEWMEXICO!DESERET
TY: EXCELLENT...
JY: YEAR
TN: YOUR SPELLING IS A LITTLE OFF.
PR:
T: DO YOU WISH TO TRY AGAIN?
A:
M: YES!YUP!YA!SUREENOUGH!YEA!OK!PLEASE!ONCEMORE
J: TERR
PR:
T:
*YEAR T:
T:
C: G = 2
C: Y = 1
T: QUESTION #G
T:
T: IN WHICH YEAR DID ARIZONA BECOME A TERRITORY?
A: #Y
T(Y=1864): VERY GOOD...
R: PROGRAM TO CONTINUE IN LIKE MANNER
E:
```

Figure 1a. PILOT Sample

Both sample PILOT programs are in the format of text files. SAMPLE occupies 20,708 bytes on 167 disk sectors. HORMUZ requires 24,800 bytes on 200 sectors. SAMPLE will engage one's imagination. The program contains scores of problems divided into four categories: numerical answer processing, textual answer processing, elementary grade examples and intermediate grade examples. The 167 sectors are the result of much painstaking programming. It shows. The examples are fitting, the computer responds with helpful witty answers, the layout is pleasantly formatted and no software problems interrupt the user.

HORMUZ, the second sample PILOT program, is a pre-algebra program embedded into a desert adventure story. The odd-ball story has no relation to the arithmetic being presented. Some would consider the tone of the story offensive, but worse, it is confusing and does not prompt in a positive manner. One of the prompts reads ". . .go back home to your parents." These 6 words quickly drain enthusiasm from kids.

One of the problems with the two sample programs is a certain scholastic attitude embedded by the various authors. This may be satisfactory for teachers' conventions, but CAI should have humility and patience. After all, it's only a machine. It *can* be programmed to reflect positive attitudes.

MICROPI is currently offering three PILOT courses: Introduction to COMMON PILOT ($100), Chemistry Laboratory Simulation ($150), and Scientific Notation Review ($75).

```
0010 GOSUB 370:LINE=160:DIGITS=0:PRINT
0020 PRINT TAB(17);"ARIZONA HISTORICAL SURVEY"
0030 PRINT TAB(17);"A SAMPLE PROGRAM IN BASIC":PRINT
0040 PRINT :PRINT
0050 LET G=G+1
0060 PRINT "QUESTION # ";G
0070 PRINT TAB(2);"IN 1860 AND BEFORE ARIZONA WAS PART";
0080 PRINT " OF WHICH TERRITORY";
0090 INPUT A$
0100 PRINT
0110 IF A$="NEW MEXICO" THEN 160
0120 IF A$<>"NEW MEXICO" THEN 130
0130 IF A$="DESERET" THEN 160
0140 IF A$<>"DESERET" THEN 150
0150 GOTO 170
0160 PRINT "EXCELLENT...":GOTO 220
0170 PRINT "I'M SORRY.  YOUR ANSWER DOES NOT MATCH."
0180 PRINT "DO YOU WISH TO TRY AGAIN, [ YES ] OR [ NO ]";
0190 INPUT X$
0200 PRINT :PRINT
0210 IF X$<>"NO" THEN 70
0220 LET G=G+1
0230 PRINT :PRINT
0240 PRINT "QUESTION # ";G
0250 PRINT TAB(2);"IN WHICH YEAR DID ARIZONA BECOME A TERRITORY"
0260 INPUT A
0270 PRINT
0280 IF A<>1864 THEN 300
0290 PRINT "VERY GOOD...":GOTO 350
0300 PRINT "NOT REALLY."
0310 PRINT "DO YOU WISH TO TRY AGAIN, [ YES ] OR [ NO ]";
0320 INPUT X$
0330 PRINT :PRINT
0340 IF X$<>"NO" THEN 250
0350 REM PROGRAM CONTINUES IN SIMILIAR FORMAT
0360 END
0370 FOR X9=1TO3:PRINTCHR$(26):NEXTX9:PRINTCHR$(2)
0380 RETURN
```

Figure 1b. BASIC Sample

Although Figure 1 contains a sample PILOT program, additional programming detail will assist in understanding the potential power of the language.

Two compatible host programs may be used to program PILOT. They are the FLEX BUILD utility within the FLEX DOS, as well as TSC's (Technical Systems Consultants, Inc.) full-sized text editor.

op code	name	comments
PR:	problem	Key construction element of PILOT. A program consists of one or more PR: codes.
R:	remark	Used for documentation.
T:	type	Display text at the terminal.
:		Continue displaying type.
A:	accept	Wait for the answer.
M:	match	Compare the answer with acceptable answers.
J:	jump	Go to various program sections.
U:	use	Internal subroutine call.
E:	end	Conclude program or subroutine.
C:	caculate	Compute an arithmetic or string function
D:	dimension	Set aside array space.
XI:	execute indirect	Perform a string instruction.

Figure 2. PILOT Operation Codes

SWTPC's PILOT uses 11 operation codes. For more information refer to Figure 2. Each code is followed by a colon after which certain instructions are carried out. For example R: is used for a remark, as in BASIC. The program does not execute R:.

To type a line of text T: is used. To accept input A: is used. M: matches a student's responses with acceptable responses. Various modifications allow the M: command to accept exact or liberal spellings, or one of a number of allowable answers.

J: allows jumps throughout the program. Jumps are simplified by three automatic jump variables that may be used as the programmer desires.

The C:, compute op code, provides PILOT with its string and mathematics power. For example, using C: A=COS(X) gives the variable A the cosine of X in radians.

PILOT string manipulation is as powerful as its sister 8K BASICs with string editing and concatenation. Figures 3 and 4 outline the PILOT mathematic and string functions.

function	comments
C: A=ABS(X)	Absolute value
C: A=ATN(X)	Arctangent in radians
C: A=COS(X)	Cosine in radians
C: A=EXP(X)	Raise to the power of
C: A=FIX(X)	Truncate
C: A=INT(X)	Integer
C: A=LOG(X)	Logrithm, base 10
C: A=LN(X)	Logrithm, base e
C: A=RND(X)	Random number
C: A=SGN(X)	Sign of X returned as -1, 0 or 1
C: A=SIN(X)	Sine in radians
C: A=SQR(X)	Square root

Figure 3. PILOT Arithmetic Functions

Like BASIC programming, PILOT is straightforward. Debugging PILOT, however, is another matter. Re-editing and re-executing the program involves a number of steps that, if slow on disk, would be impossible on tape.

function	comments
C: A=ASC(X$)	Returns number of first ASCII letter in string X$
C: A=CHR(X)	Returns the ASCII of a given number
C: A=FLO(X$)	Returns numeric value of first number in string
C: A=INS(X,Y$,Z$)	Returns number of starting position of Z$ in Y$ starting at X
C: A=LEN(X$)	Returns number of string's length
C: A=STR(X)	Converts decimal or floating point math into a string.

Figure 4. PILOT String Functions

A debugging hassle is created because SWTPC PILOT does not respond to control C or ESCAPE. It is necessary to reactivate the monitor to escape from the program.

Error statements are single letters. As such they tend to be general. The offending line is displayed but the error statements do not have the detail found in other SWTPC BASICs.

SWTPC's PILOT may iron out a few of the rough spots in future revisions. Getting rid of the calculator interface and SWTBUG difficulties would be nice. The manual should contain at least one printout of a complete PILOT program for analysis. The program would not have to be as complex as those on the disk. Something more than the few-line samples in the documentation is necessary. Better documentation indexing would also be helpful.

However, SWTPC and MICROPI should be congratulated for this quality software that works. They have given their software a solid foundation. Craftsmanship is noticeable everywhere. Now we must wait a season for the variety of software to develop. Based on the work that has already gone ahead, a bumper crop should be coming.☐

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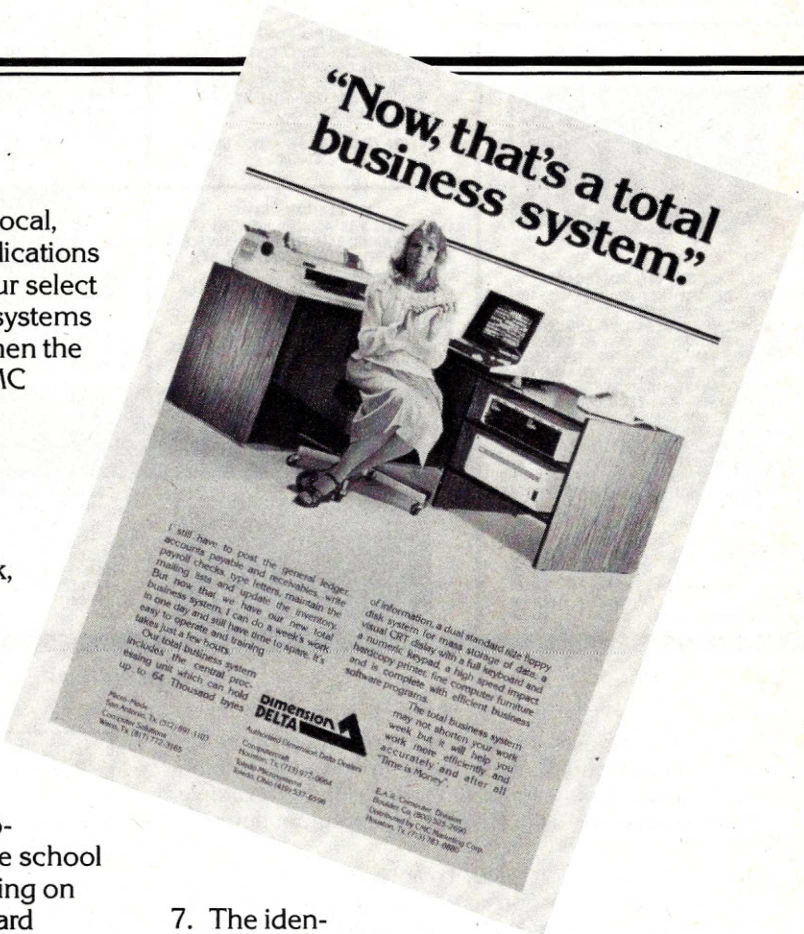

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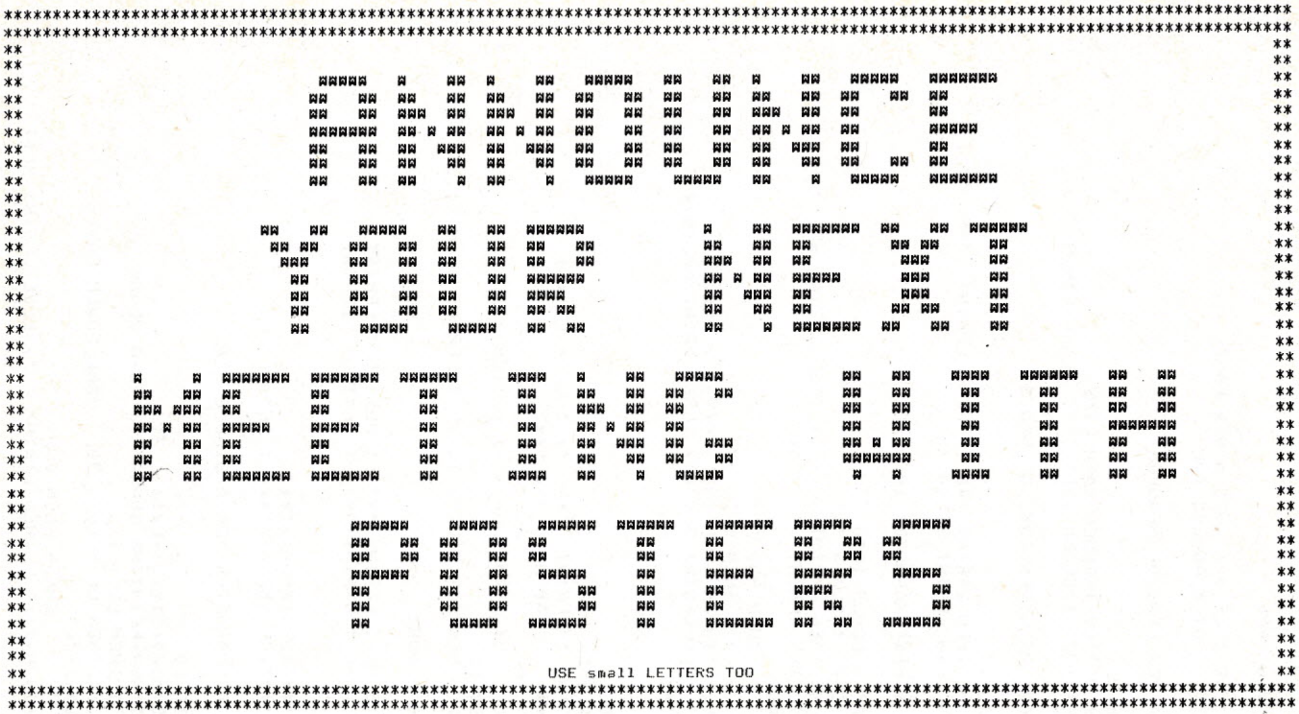


By Alan R. Miller, Software Editor

Computers are principally used for computation and data processing. But a third possible use is for making posters. One popular style depicts cartoon characters such as Snoopy or Star Wars robots with a calendar at the bottom. Long, sideways banners of block letters are also common.

The program given in Listing 1 can be used to produce yet a different style of poster. In this case it is closer to something that might be ordered from a sign painter. The announcement of an important meeting, for example, can be printed in 1 by ¾-inch block letters. Then additional information can be given in smaller letters at the bottom of the sign. A border of two rows of stars surrounds the entire message.

WRITTEN IN BASIC

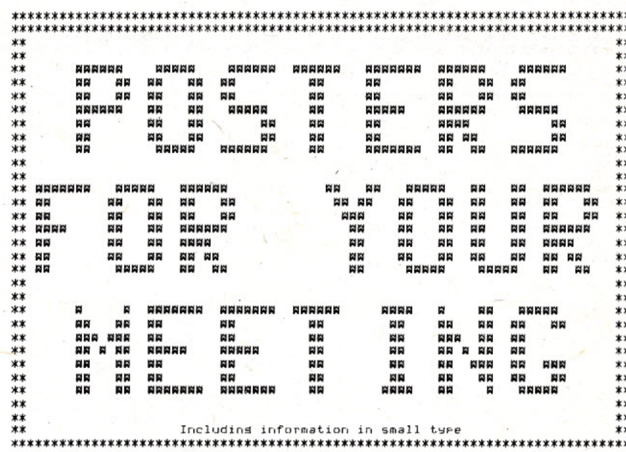
The program, written for Microsoft BASIC, produces 14 block letters per line for a 132-column line printer. If an 80-character printer is used, a maximum of 8 letters can be placed on each line. In this case, remove the apostrophe from the beginning of line 170. (It is also possible to squeeze seven letters onto a line for printing on a teletype.)

The program will run on Xitan disk BASIC if the integer definition at line 110 is deleted. Two other changes must be made for the latest Xitan version. The LPRINT commands must be changed to PRINT #LU and the LINE INPUT commands are changed to INPUT LINE #0.

The LINE INPUT command accepts a string of ASCII characters including punctuation and quotation marks. If this command is not available, the regular INPUT command can be substituted. But in this case the user response must be embedded in quotation marks if it contains punctuation.

RUNNING THE PROGRAM

Type RUN and the program will prompt the user for the page length and number of copies. The message to be printed in large block letters is typed in next. Start each line with the actual first character. It is not necessary to add blanks on the left, since each line is automatically centered by the addition of blanks to each end. Lines with an odd number of characters are padded with half blanks, shifting these lines by one-half character. Two successive carriage returns complete this part. Of course, the BASIC error-correction keys can be used to fix typing errors made during entry.



SMALL LETTERS

Lines which will print in small letters (actually the regular printer characters) are entered next. These lines are also centered automatically and can contain up to 127 letters for the wide format. Two successive carriage returns complete the input and initiates the printout. At the completion of each poster, the proper number of linefeeds are issued to simulate a formfeed.

The data used to generate the block letters are given at the end of BASIC program. The DATA statements are written in the actual ASCII characters whenever possible for greater clarity. However, the resulting block letters, printed in 7-by-7 format, are formed by overprinting the letter A with the letter W. This produces a much more readable sign than if single characters were to be used.□

Program follows

PROGRAM LISTING

```
10 ' BASIC PROGRAM TO PRINT POSTERS, MAR 7,79
20 '
30 ' Written by Alan R. Miller
40 ' New Mexico Tech,  Socorro  87801
50 '
60 ' FOR XITAN VERSION DELETE LINE 110
70 '   CHANGE LPRINT TO PRINT #LU,
80 '   CHANGE LINE INPUT TO INPUT LINE #0,
90 '
100 CLEAR 1000 ' SET STRING SPACE
110  DEFINT I-N : REM MICROSOFT VERSION
120  LU = 2 ' LOGICAL-UNIT FOR LIST, XITAN VERSION
130 ' OPTION #LU,"W",132 ' SET WIDTH XITAN VERSION
140 '
150 CR$ = CHR$(13)
160 MC=14 'MAXIMUM CHARACTERS PER LINE
170 ' MC = 8 : REM FOR NARROW PAPER
180 MP = MC * 9 + 5 : ML= 9 ' MAXIMUM NUMBER OF LINES
190 MS = 15 'MAX NUMBER OF SMALL LINES
200 '
210 DIM SI$(ML),AL$(7,63),IZ(ML),SM$(MS),IY(MS)
220 '
230 E1$ = "ERROR: too many characters, try again "
240 '
250 FOR J=1 TO 59 : FOR I=1 TO 7 : READ AL$(I,J)
260 NEXT I,J
270 '
280 INPUT "Page length, in inches"; YP :  LP = YP * 6
290 INPUT "Number of copies"; NC
300 PRINT "Enter message of large letters, up to";
310 PRINT MC;" letters per line."
320 PRINT "Two successive carriage returns signify end."
330 '
340 I=0
350 I=I+1 : IZ(I)  = 0
360 PRINT "Line" + STR$(I);":";
370 LINE INPUT SI$(I) ' INPUT A LINE OF LARGE LETTERS
380 LN = LEN(SI$(I))
390 IF LN > MC THEN PRINT E1$ : GOTO 360
400 IF LN = MC THEN 460
410 IF LN = 0 THEN NL = I - 1 : GOTO 480
420 N1 = MC - LN : N2 = INT(N1/2) : N3 = N1 - N2
430 IF N1 = 1 THEN 450
440 FOR J = 1 TO N2 : SI$(I)= " "+ SI$(I) : NEXT J
450 IF N2 <> N3 THEN IZ(I) = 1 ' SET HALF-SPACE FLAG
460 IF I < ML THEN 350
470 '
480 PRINT "Enter small lines"
490 I = 0
500 I = I+1 : IY(I) = 0
510 PRINT "Line" + STR$(I);":";
520 LINE INPUT SM$(I) ' INPUT A LINE OF SMALL LETTERS
530 LN= LEN(SM$(I))
540 IF LN = 0 THEN NS = I - 1 : GOTO 580
550 IF LN > MP-6 THEN PRINT E1$ : GOTO 510
560 IF LN<MP THEN SM$(I) = SPACE$((MP-LN)/2-4) + SM$(I)
570 IF I < MS THEN 500
580 LPRINT
590 '
600 ' START A NEW PAGE
610 '
620 FOR K=1 TO NC : LT = 6 'GET A NEW PAGE
630  GOSUB 1020 ' PUT * ACROSS TOP
640  '
650  ' START A NEW LINE OF MESSAGE
660  '
670 FOR J=1 TO NL
680  LT = LT + 9 ' GO THROUGH EACH LINE
690  LS= LEN(SI$(J)) : GOSUB 1060   ' 2 BLANK LINES
700  '
710  ' START ONE OF SEVEN ROWS OF SPOTS
720  '
730  FOR I=1 TO 7
740   IF LS = MC THEN LPRINT "** "; ELSE LPRINT  "**  ";
750   IF IZ(J) THEN LPRINT SPC(4);
760   '
770   ' SELECT A NEW CHARACTER IN LINE
780   '
790   SP$ = "A" : GOSUB 1080
800   LPRINT  CR$; : SP$ = "W"
810   IF LS = MC THEN LPRINT SPC(3); ELSE LPRINT SPC(4);
820   IF IZ(J) THEN LPRINT  "    ";
830   GOSUB 1080
840   IF LS >= MC THEN 880
850   IF MC - LS <= 1 THEN GOTO 870
860   FOR L= LS+2 TO MC : LPRINT SPC(9); : NEXT L
870   IF IZ(J) THEN LPRINT SPC(4); ELSE LPRINT SPC(8);
880   LPRINT "**"
890  NEXT I
900 NEXT J
910 GOSUB 1060
920  IF NS = 0 THEN 960
930 FOR J=1 TO NS : LPRINT  "**   "; : LT = LT + 1
940 LPRINT  SM$(J); TAB(MP - 2); "**"
950 NEXT J
960 GOSUB 1020 ' PUT 2 ROWS OF * AT BOTTOM
970 LT = LT MOD LP
980  IF LT+1-LP THEN FOR J=LT+1 TO LP : LPRINT  : NEXT J
990 NEXT K
1000 GOTO 2440 ' DONE
1010 '
1020 FOR L=1 TO MP : LPRINT "*"; : NEXT L : LPRINT
1030 FOR L=1 TO MP : LPRINT "*"; : NEXT L : LPRINT
1040 RETURN
1050 '
1060 LPRINT   "**";SPC(MP-4);"**"
1070 LPRINT   "**";SPC(MP-4);"**" : RETURN
1080 '
1090 ' SELECT A CHARACTER FOR A SINGLE LINE
1100 '
1110 FOR L=1 TO LS
1120  LL = ASC(MID$(SI$(J),L,1)) -31
1130 ' CONVERT NON-PRINTING CHARACTER TO A BLANK
1140  IF LL < 1 THEN LL = 1
1150  IF LL > 64 THEN LL = LL - 32 ' MAKE LOWER CASE
1160  A2$ = AL$(I,LL)
1170  FOR M=1 TO 7 ' CHECK EACH SPOT
1180 IF MID$(A2$,M,1)=" " THEN LPRINT " "; ELSE LPRINT SP$;
```

```
1190  NEXT M : LPRINT  "  ";
1200 NEXT L
1210 RETURN
1220 '
1230 ' CHARACTER DATA
1240 '
1250 DATA "          ","          ","          ","          ","          "
1260 DATA "          ","          "
1270 DATA "    !     ","    !     ","    !     ","    !     ","    !     "
1280 DATA "          ","    !     "
1290 DATA "          "," XX XX    "," XX XX    "," XX XX    ","          "
1300 DATA "          ","          "
1310 DATA "   # #    ","   # #    ","#######,"   # #    ","#######
1320 DATA "   # #    ","   # #    "
1330 DATA " $$$$$$","$$ $     ","$$ $     "," $$$$$   ","    $ $$"
1340 DATA "    $ $$","$$$$$$   "
1350 DATA " %%%%%%"," %%  %   ","    %    ","    %    ","    %    "
1360 DATA " %  %%  ","%   %%   "
1370 DATA "  &      "," & &      ","  &      "," & &     ","&    & &"
1380 DATA "&     & "," &&&& &"
1390 DATA "          ","  ''      ","  ''      ","   '      ","          "
1400 DATA "          ","          "
1410 DATA "        (","       (  ","     (    ","     (    ","     (    "
1420 DATA "      ( ","    ("
1430 DATA ")         "," )        ","   )      ","   )      ","   )      "
1440 DATA " )        ",")"
1450 DATA "*  *  *"," * * * ","   ***    ","*******","   ***    "
1460 DATA " * * * ","*  *  *"
1470 DATA "   +      ","   +      ","   +      ","+++++++","   +      "
1480 DATA "   +      ","   +      "
1490 DATA "          ","          ","          ","          ","          "
1500 DATA "    ,     ","    ,     "
1510 DATA "          ","          ","          ","   ---    ","          "
1520 DATA "          ","          "
1530 DATA "          ","          ","          ","          ","          "
1540 DATA "   ..     ","   ..     "
1550 DATA "         /","       /  ","     /    ","    /     ","   /      "
1560 DATA " /        ","/"
1570 DATA " 00000 ","0      0,0      0,0      0,0      0
1580 DATA 0      0," 00000 "
1590 DATA "   1     ","  11    "," 1 1    ","   1     ","   1     "
1600 DATA "   1     "," 11111 "
1610 DATA "  2222 "," 2     2","     2 ","     2 ","     2     "
1620 DATA "  2     "," 222222"
1630 DATA " 33333 ",3       3","      3","   33 ","       3"
1640 DATA "3      3"," 33333 "
1650 DATA "     44 ","  4  4 "," 4    4 ","444444 ","      4 "
1660 DATA "     4 ","     4 "
1670 DATA "555555 ","5       ","5       ","55555   ","      5 "
1680 DATA "      5 ","55555   "
1690 DATA " 6666   ","6        ","6        ","66666   ","6     6 "
1700 DATA "6      6 "," 6666   "
1710 DATA 7777777,"      7 ","     7 ","     7 ","     7    "
1720 DATA " 7      ","77"
1730 DATA "  8888 "," 8     8"," 8     8"," 8888 "," 8     8"
1740 DATA " 8     8","  8888  "
1750 DATA "  9999 "," 9     9"," 9     9"," 99999","      9"
1760 DATA "      9"," 9999  "
1770 DATA "          ","  ::      ","  ::      ","          ","  ::      "
1780 DATA "  ::      ","          "
1790 DATA "          ","  ;;      ","  ;;      ","          ","  ;       "
1800 DATA "  ;       ","          "
1810 DATA "      <   ","    <     ","   <      "," <        ","   <      "
1820 DATA "   <     ","    <    "
1830 DATA "          "," =====    "," =====    ","          "," =====    "
1840 DATA " =====    ","          "
1850 DATA "  >       ","    >     ","     >    ","     >    ","   >      "
1860 DATA "   >     ","   >     "
1870 DATA " `???    "," ?   ?   ","      ?  ","     ?   ","    ?     "
1880 DATA "          ","  ?       "
1890 DATA "          ","          ","          ","          ","          "
1900 DATA "          ","          "
1910 DATA " AAAAA ",AA    AA,AA    AA,AAAAAAA
1920 DATA AA    AA,AA    AA,AA    AA
1930 DATA "BBBBBB ",BB    BB,BB    BB,"BBBBBB "
1940 DATA BB    BB,BB    BB,"BBBBBB "
1950 DATA" CCCCC ",CC    CC,"CC      ","CC      ","CC      "
1960 DATA CC    CC," CCCCC "
1970 DATA "DDDDDD ",DD    DD,DD    DD,DD    DD
1980 DATA DD    DD,DD    DD,"DDDDDD "
1990 DATA EEEEEEE,"EE      ","EE      ","EEEEE   ","EE      "
2000 DATA "EE      ",EEEEEEE
2010 DATA FFFFFFF,"FF      ","FF      ","FFFF    ","FF      "
2020 DATA "FF      ","FF      "
2030 DATA " GGGGG ",GG    GG,"GG      ","GG      ",GG   GGG
2040 DATA GG    GG," GGGGG "
2050 DATA HH    HH,HH    HH,HH    HH,HHHHHHH,HH    HH
2060 DATA HH    HH,HH    HH
2070 DATA "  IIII  ","   II   ","   II   ","   II   ","   II   "
2080 DATA "   II   ","  IIII  "
2090 DATA "      JJ","      JJ","      JJ","      JJ","      JJ"
2100 DATA " JJ   JJ","  JJJJ "
2110 DATA KK    KK,"KK   KK ","KK KK   ","KKKK    ","KKKKK   "
2120 DATA "KK   KK ",KK    KK
2130 DATA "LL      ","LL      ","LL      ","LL      ","LL      "
2140 DATA "LL      ",LLLLLLL
2150 DATA M      M,MM    MM,MMM MMM,MM M MM,MM    MM
2160 DATA MM    MM,MM    MM
2170 DATA N      NN,NN    NN,NNN   NN,NN N NN,NN   NNN
2180 DATA NN    NN,NN      N
2190 DATA " OOOOO ",OO    OO,OO    OO,OO    OO,OO    OO
2200 DATA OO    OO," OOOOO "
2210 DATA "PPPPPP ",PP    PP,PP    PP,"PPPPPP "
2220 DATA "PP      ","PP      ","PP      "
2230 DATA " QQQQQ ",QQ    QQ,QQ    QQ,QQ    QQ
2240 DATA QQ    QQ,QQ  QQQ," QQQQQQ"
2250 DATA "RRRRRR ",RR    RR,RR    RR,"RRRRRR ","RRRR    "
2260 DATA "RR RR  ","RR   RR "
2270 DATA " SSSSSS","SS      ","SS      "," SSSSS ","      SS"
2280 DATA "      SS","SSSSSS "
2290 DATA "TTTTTT ","   TT   ","   TT   ","   TT   ","   TT   "
2300 DATA "   TT   ","   TT   "
2310 DATA UU    UU,UU    UU,UU    UU,UU    UU,UU    UU
2320 DATA UU    UU," UUUUU "
2330 DATA V      V," V     V"," VV  VV"," V   V ","  VVVV "
2340 DATA "   VV  ","   VV   "
2350 DATA WW    WW,WW    WW,WW    WW,WW    WW,WW W WW
2360 DATA WWWWWWW," W    W "
2370 DATA XX    XX," XX XX "," XXX    "," XXX    "," XXX    "
2380 DATA " XX XX ",XX    XX
2390 DATA YY    YY," YY YY "," YYY    ","   YY   ","   YY   "
2400 DATA "   YY   ","   YY   "
2410 DATA ZZZZZZZ,"      Z ","     Z  ","    Z   ","   Z    "
2420 DATA " Z      ",ZZZZZZZ
2430 '
2440 END
```

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*Manufacturer requests factory-direct inquiry.

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